NBSIR 76-1094 (R)

Standards for Computer Aided Manufacturing

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Office of Developmental Automation and Control Technology
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National Bureau of Standards
Washington, D. C. 20234

Second Interim Report

October, 1976

Prepared for

Manufacturing Technology Division
Air Force Materials Laboratory
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U.S. DEPARTMENT OF COMMERCE, Elliot L. Richardson, *Secretary*

Edward O. Vetter, *Under Secretary*

Dr. Betsy Ancker-Johnson, *Assistant Secretary for Science and Technology*

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Acting Director*

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Standard Class	Major Stds.	Standard Designation	Conflicts	Implementations	Comments	Page #
A. NC Programming Languages	*	X3.37 (APT)	COMPACT II	Widespread	Most comprehensive NC language.	7
	*	COMPACT II/ACTION/SPLIT	APT	Widespread	Easier than APT for simple parts; no formal standard yet.	9
B. CAD/CAM Interface	*	IPAD (Integrated Program for Aerospace-Vehicle Design	None	None; in development	IPAD will set defacto standard; conflicts may develop.	11
		IPC-D-350A (Printed Circuit Boards)	None	Widespread	Tutorial example; PC boards only.	13
	*	ANSI Y14.26.1 (Digital Representation of Physical Object Shapes)	None	None; in development	Intended for transfer of part geometry data.	15

SUMMARY MATRIX COMPUTER STANDARDS

Standard Class	Major Stds.	Standard Designation	Conflicts	Implementations	Comments	Page #
A. Communications 1. Hardware	*	EIA RS-232-C (Serial Binary Data Interchange)	CCITT X.21	Universal	For connection of digital terminal to analog communication system. Used for CRT's, NC tools, other periphals and communications.	18
	*	EIA SP-1194A (Data Terminal Data Communication Interface) (RS XYZ)	Will supersede RS-232-C	Future	Will supersede RS-232-C, IC compatible, higher data rates. Known as RS XYZ until adopted.	19
	*	CCITT X.21 (Digital Data Terminal/Data Communication Interface)	RS-232-C, RS XYZ	Limited But Increasing	Defines interface to digital communications system. Will be important by 1980's with digital telephone system. Will be adopted by ANSI.	33
		ANSI X3.24 (Signal Quality)	None	Almost Universal		20
		EIA RS-408 (NC/DTE Interface)	IEEE 488	Extensive	Byte serial. Used with NC tools, paper tape interfaces	21
		IEEE 488 (Programmable Instrumentation Interface)	EIA RS-408 and IEEE 583	Limited	Instrumentation uses.	22
		IEEE 583 (CAMAC)	EIA RS-408, RS-232-C & IEEE 488	Limited But Increasing	Instrumentation uses in Nuclear Field	23
		FIPS PUB 22-1 (Sychronous Signaling Rates)	None	Extensive		24
		FIPS PUB 16 (Bit Sequencing)	Numerous	Extensive		25
		FIPS PUB 17 (Serial-by-Bit ASCII)	Some Proprietary	Extensive	Bit Sequence specified in FIPS PUB 16	26
		FIPS PUB 18 (Parallel-by-Bit ASCII)	Some Proprietary	Most Parallel-By-Bit		27
		FIPS PUB 37 (Synchronous High Speed Signaling Rates)	None			28
		EIA RS-422 (FED-STD-1020; Balanced Voltage Circuits)	None	Limited	Electrical standard for high speed RSXYZ	29
		EIA RS-423 (FED-STD-1030; Unbalanced Voltage Circuitry)	None	Limited	Electrical standard for low speed RSXYZ	30
		CCITT V.28 (Unbalanced Double-Current Circuits)	EIA RS-232-C	Europe		31
		CCITT V.31 (Single-Current Circuits)	None	Europe		32

SUMMARY MATRIX COMPUTER STANDARDS CONT.

		ANSI X3T92/D64 (Proposed Minicomputer Interface)	None	Limited	For minicomputer peripherals.	34
		ANSI X3T9/60D (Proposed Channel Interface)	None	Widespread	Large computer peripherals interface.	35
2. Codes	*	FIPS PUB 1 (ASCII)	Numerous	Extensive	Fundamental Standard, Conflict with EBCDIC	36
		ISO 646 (7-bit Code)	Numerous	Extensive		3B
		CCITT V.3 (International Alphabet)	Numerous	Extensive		39
	*	IBM CSS 3-322D-DD2 (EBCDIC)	Numerous	Extensive: IBM	In conflict with ASCII	40
		Encryption Algorithm	None	Some Future	For secure data transmission	41
	*	EIA RS-358 (NC ASCII Subset)	EIA RS-244A	All Newer, NC Tools	Code for NC Data. RS-244A (Flexomoniter code) no longer supported by EIA	42
	*	EIA RS-274-C (NC Variable Block Format)	None	Extensive	Current NC Data Format Standard	43
	*	EIA SP-1177A (Advanced NC)	None	All US NC Tools in Future	Future NC (CNC) Data Formats	44
		FIPS PUB 36 (ASCII Graphics)	None	Some		45
		FIPS PUB 14(Hollerith Code)	IBM System 3	Extensive	Punched Card Code	46
		FIPS PUB 2(PPT Code)	Teletypesetter & other older codes	Extensive	Punched Tape Code	4B
3. Protocol (Link Level)		ANSI X3.28 (Character Oriented	IBM BISYNC, ADCCP	Many, Incompatable	The standard lists some 4D incompatable implementations.	49
	*	ANSI S3534/589(ADCCP)	ANSI X3.28, IBM BISYNC, DEC DDCMP	Near Future, Extensive	Proposed Bit Oriented Standard. Compatible with IBM SDLC, ISO HLDC	5D
		DEC DDCMP	ANSI X3.28, ADCCP, SDLC, BISYNC	Some DEC	Corporate standard. Conflict with ADCCP	51
4. Protocol (Network Level)		IBM SNA	CCITT X.25, DNA, ARPANET	Some IBM	Not intended as standard.	52
	*	CCITT X.25	SNA, DNA	Some, extensive in future	Draft standard. Incorporates ADCCP. Major packet network standard.	53
		ARPANET IMP/HOST			De facto standard. Commercial networks will follow X.25.	54
		DEC DNA	SNA, CCITT X.25, ARPANET	Partial DEC		55
B. Computer Programming Languages 1. General Purpose		ANSI X3J2/76-D1 (BASIC)	None	Extensive	Proposed standard. Time sharing use.	56
		FIPS PUB 21-1 (COBDL)	None	Extensive	Widespread business use	58
		ANSI X3.9 (FDRTRAN)	PL/I	Extensive	Widespread scientific. engineering use	59

SUMMARY MATRIX COMPUTER STANDARDS CONT.

		MDC/28, 33 & 34 (MUMPS)	None	Extensive	Proposed ANSI standard. Used for inventory control.	6D
		PASCAL	None	Some	Academic Popularity; Not a standard.	61
	*	ANSI BSR X3.53 BASIS/ 1-21 (PL/I)	COBOL, FORTRAN	Some, large machines	Current standard does not define subsets. Only standardized "modern" language.	62
2. Simulation		(SUMMARY SHEET)			No standards.	63
3. Machine Oriented System Implementation		BLISS	All SILS are competitive	Limited (DEC)	No standards.	64
	*	PL/S		Some IBM	IBM system language; propriety; extension of PL/I	65
		BCPL & C		Some DEC, IBM, Honeywell	Examples of modern, user oriented SILS.	66
4. Artificial Intelligence	*	PL/M, PL/M6800 and MPL (SUMMARY SHEET)		Some DEC, IBM	Subsets of PL/I for Cross Software support for microcomputers. No standards.	68
C. Data Base Management Systems 1. CODASYL DBTG		CDDASYL DBTG	All DBMS approaches are competitive.	Limited But Increasing	CDBDL based. Closest to formal standard. Network structure important.	69
2. Non-CODASYL Self-Contained		(SUMMARY SHEET)		Extensive	Commercial, self contained DBMS systems	71
3. Non-CODASYL Host Language		(SUMMARY SHEET)		IBM	Examples are IMS and TOTAL. Hierarchical structures. Extensions to programming languages	73
4. Relational Approach		(SUMMARY SHEET)		Future	Research area.	74
D. Operating Systems		(SUMMARY SHEET)			No standards.	75
E. Validation and Testing 1. Compiler/Interpreter	*	(SUMMARY SHEET)	None	COBDL, Others in Future	Important means for insuring portability	76
2. Mathematical Software		(DVERVIEW)	Some IBM UNIVAC	Limited		77
F. Documentation 1. Program & System	*	FIPS PUB 38 (Program Doc'n)	None	Extensive	Documentation standards should be mandatory	79
		FIPS PUB 3D (Software Summary)	None		ANSI X3K7 developing abstract form	80
		FIPS PUB (Flowchart Symbols)	None			81
2. Data Elements	*	(SUMMARY SHEET)			Existing data element standards not CAM oriented	83
3. Vocabulary/Nomenclature		FIPS PUB 11/(General ADP)	None		ANSI developing new dictionary	84
		ANSI X8.1 (AXIS & MOTIDN)	None	Extensive		85

SUMMARY MATRIX COMPUTER STANDARDS CONT.

4. Representation of Values		ANSI X3.42 (Numeric Values)	None	Becoming Universal	Important for intersystem compatibility	86
G. Media 1. Punched Cards	*	ANSI X3.26 (Hollerith Punched Card Code); ANSI X3.11 (Specification for General Purpose Paper Cards for Information Processing); ANSI X3.21 (Rectangular Holes in 12-Row Punched Cards)	96-Column IBM	Almost Universal	Should be mandatory if cards are used	87
2. Magnetic Tape	*	EIA RS-346 (Type A Hubs and Reels and Magnetic Tape);	None	Universal		89
		ANSI X3.14 (Recorded Magnetic Tape for Information Interchange (200 CPI, NRZI)); ANSI X3.22 (Recorded Magnetic Tape for Information Interchange (200 CPI, NRZI)); ANSI X3.40 (Unrecorded Magnetic Tape for Information Interchange (9-Track 200 and 800 CPI, NRZI, and 1600 CPI, P.E.)); ANSI X3.39 (Recorded Magnetic Tape for Information Interchange (1600 CPI, P.E.)); ANSI X3.54 (Recorded Magnetic Tape for Information Interchange (6250 CPI, GCR));	Tape Standards are in conflict.	Universal	Magnetic Tape Standards will be a necessity.	
	*	FIPS PUB 25 (Recorded 1600 CPI)	Non-ASCII formats	Extensive	Recommended Federal Standard.	90
		ANSI BSR X3.43 (Cassettes)	None	Extensive		91
		ANSI BSR X3.56 (Cartridge)	None	Some		92
3. Paper Tape		ANSI X3.6 (Perforated Tape Code for Information Interchange);	None	Extensive	Widely used in NC; not recommended for other uses.	93
		ANSI X3.18 (One-Inch Perforated Paper Tape for Information Interchange);	X3.19	Extensive	Paper tape not recommended.	
		ANSI X3.19 (Eleven-Sixteenths Inch Perforated Paper Tape for Information Interchange ANSI X3.29 (Specifications for Properties of Unpunched Oiled Paper Perforator Tape); ANSI X3.20 (Take-Up Reels for One-Inch Perforated Tape for Information Interchange	X3.18	Limited		

I. INTRODUCTION

The Air Force is initiating a major new program to accelerate the establishment of Integrated Computer Aided Manufacturing (ICAM) in discréte part batch manufacturing industries in the United States, specifically in the aerospace industry. The National Bureau of Standards is providing support to that program by analyzing existing standards relevant to Integrated Computer Aided Manufacturing.

This document is the second interim report to the Air Force Manufacturing Technology Division of the Air Force Materials Laboratory at Wright-Patterson Air Force Base on the ICAM support project. This report covers tasks 2 and 3 of the 5 tasks of the project:

Task 2 Analyze existing standards
Task 3 Assess the usage of standards in industry.

The report takes the form of an annotated bibliography with common format data sheets for ease of reference. Except for noting the relation to other standards, including competitive standards, there are no evaluations or recommendations made on the possible use of these standards in the Air Force ICAM program. This report does provide a comprehensive reference data base on those formal and de facto standards that are considered to be relevant to the Air Force program.

Using this data base, the third interim report will evaluate the use of these standards in the Air Force Program and will hypothesize optimal standards for that Program.

The context of selecting these standards for discussion was provided in the first interim report of this project, issued July, 1976. The key concepts identified in that report for choosing system standards were:

- System integration: data and communication interfaces between CAM application programs.
- Software portability: interfaces between CAM programs and the host computer system, including languages, operating systems, and data base management system interfaces.
- Integration of distributed systems: interfaces between computers in distributed systems.

These concepts led to identification and investigation of the communication and computer system standards included in this report. In addition, data sheets are included on the formal standards that exist for CAM: NC part programming languages at the interface between CAD and CAM.

An explanation of the categories in the data sheets is given, with examples, in Table 1.

TABLE 1

DATA SHEET FORMAT

ENTRY	EXPLANATION	EXAMPLES
1. Designation	Document ID numbers from highest to lowest levels of approval	·FIPS PUB 1, ANSI X3.4-1968, EIA . . .
2. Title	Name of standard	·American Standard Code for Information Interchange (ASCII)
3. Maintenance Authority	Name of organization(s) authorized to maintain the specification	·ANSI X3L2 or ·IBM Corporation
4. Scope	General statement regarding the functional use of the standard	·Hardware, asynchronous data transmission
5. Relationship to Other Standards	Name of other standards noting relationship that <u>those other</u> standards have with <u>this</u> standard; relationships may be: superset (of), subset, extension, implementation, base (for), dialect, minor deviation (from), etc.	·CODASYL COBOL (superset) or ·ANSI X3.23-1968 (subset)
6. Competitive Standards	Name other standards that tend to be mutually exclusive	·ANSI X3.4-1968 or ·EBCDIC
7. Standardization Status	Cite major specification and acceptance actions	·ANSI standardization completed May 1966; Revision being ballotted upon, action dated December 1976; New designation to be ANSI X3.9-1976
8. Implementation Status	On what machines/systems has it been installed	·All general purpose computers or ·IBM/370, Burroughs B-6700
9. Known Manufacturing Uses	Generic or specific applications in manufacturing industry	·Business applications or ·Scientific applications or ·Inventory control, parts cataloguing or ·Numerical control: positioning and contouring

10. Known Sources of Information	List of primary information source(s) for future inquiries on specific standards	
11. Probable Sources of Information	List of secondary sources of information	·CAM-I, Inc. ·Boeing Computer Services, Inc.
12. Bibliography	Citation of the standard and, perhaps, related documents	·FIPS PUB 1, ANSI X3.4-1968 or ·FIPS PUB 23, ANSI X3.28-1968; COBOL Journal of Development, 1974
13. Comments	Clarifying information, as needed	
14. Footnotes	Other information, as needed	

TABLE 2

Abbreviations of Names of
Standards Organizations

FIPS	Federal Information Processing Standards
ANSI	American National Standards Institute, Inc.
EIA	Electronic Industries Association
ISO	International Organization for Standardization
CCITT	International Consultative Committee on Telegraph and Telephone
CBEMA	Computer and Business Equipment Manufacturers Assocation
IPC	Institute for Printed Circuits
NASA	National Aeronautics Space Administration
CAM-I	Computer Aided Manufacturing - International, Inc.
IEEE	Institute for Electrical & Electronics Engineer, Inc.
NMTBA	National Machine Tool Builders Association

CAM STANDARDS

1. Designation: ANSI X3.37-1974

2. Title: Automatically Programmed Tool (APT)

3. Maintenance Authority: ANSI X3J7 and ISO/TC97/SC9

4. Scope: Programming language used for Numerical Control (N/C) machine tools in discrete part manufacturing and tooling manufacturing, for surface definition, and as a subset of graphics and process planning programs for all of the above.

5. Relationship to Other Standards:

   ARELEM - 1971 (subset)
   ARLM1 - 1975 (subset)
   SSX5 - 1975 (extension)
   CASPA - 1975 (pre-subset)
   ADAPT - (subset)
   UNIAPT - (Comparable except for the size of computer and mode of operation)
   ISO/DIS 3592 - 1975 (Pseudo-subset) the ISO CL DATA standard derived from APT.

6. Competitive Standards: SPLIT/ACTION/COMPACT II Languages

7. Standardization Status: In 1963, the Business Equipment Manufacturer's Association (BEMA) sponsored the formation of the American National Standards Institute (ANSI) subcommittee X3J7 to create a standard for the APT language. The standard was submitted for approval in May, 1973. The first APT Language Standard was published by ANSI in June 1974. It is designated ANSI X3.37. This standard was revised in March 1975 and a draft (X3J7/55-80) is presently being circulated for comments. Final approval is expected by November 1976. The revised standard will be designated ANSI X3.37-1976. The major revision is the addition of the APT N/C post processor language in the standard.

   FIPS Task Group 19 is studying the suitability of this revised form of the APT Standard for use as a Federal Standard. A draft Federal Standard is expected by September 1977.

8. Implementation Status: The APT Language is implemented on IBM 704, 709, 7090, 360, 370, UNIVAC 1108. General Electric's international computer service network. APT is also fully or partially implemented on Fujitsu, Control Data Corporation, Siemens, and English Electric Computers.

9. Known Manufacturing Uses: Approximately 20% of the parts made on N/C tools are programmed in APT.

10. Known Sources of Information:

    Computer and Business Equipment Manufacturers Association (CBEMA)
    Secretariat of ANSI X3
    1828 L Street, NW
    Washington, D.C. 20036

    CAM-I, Inc. (Computer Aided Manufacturing-International, Inc.)
    611 Ryan Plaza Drive, Suite 1107
    Arlington, Texas 76012

11. Probable Sources of Information:

IBM (International Business Machines) Corp.
Data Processing Division
1133 Westchester Avenue
White Plains, New York 10604

12. Bibliography:

ANSI X3.37 - 1974
IBM SYSTEM/370 APT-BP Numerical Control Processor General Information Manual
IBM SYSTEM/370 APT-IC & APT-AC Numerical Control Processor General Information Manual

13. Comments: APT is the first of the N/C Languages, provides the most sophisticated capabilities, and is presently the most widely used, with about 20% of all N/C machined parts being programmed in APT. Development work includes a geometric modeling project for processing a wide variety of engineering shapes, an improved Arithmetic Element, and a sculptured surfaces project to extend the geometric capability of APT to unconventional analytical as well as non-analytical shapes.

Developmental work is primarily carried out by CAM-I, Inc., which has taken over the work of the APT Long Range Program (ALRP) formerly at the Illinois Institute of Technology Researcn Institute (IITRI).

Major problems still remain with post processor and controller source code incompatibilities that make it impossible to transfer either Cutter Location (CL) file tapes or machine tapes from one machine tool or facility to another without at least some modifications.

1. Designation: N.A.

2. Title: COMPACT II/ACTION/SPLIT (COMputer Program for Automatically Controlling Tools II/ACTION/Sundstrand Processing Language Internally Translated)

3. Maintenance Authority: ANSI X3J5, Manufacturing Data Systems Inc. (MDSI)

4. Scope: Programming Language for describing operations for numerically controlled machines.

5. Relationship to Other Standards: N.A.

6. Competitive Standards: APT is the main competitive language; there are approximately 40 other NC programming languages.

7. Standardization Status: Initial proposal for a standard was reviewed by CBEMA SPARC committee June 17, 1975. This committee recommended that a study group be formed and the X3/SPARC Study Group held its first meeting September 30, 1975. As a result the COMPACT II/ACTION/SPLIT Standard proposal was modified and forwarded to X3 with the recommendation that an X3J* standards committee be formed in order to produce a standard within 12 to 24 months. X3J5 held its first meeting in March, 1976.

8. Implementation Status:

SPLIT has be implemented on the DEC PDP 11/20 and the IBM 360/30.
ACTION has been implemented on the DEC PDP 11, DEC PDP 10, IBM 360, IBM 370.
COMPACT II is available only in the remote time-sharing mode on two world-wide networks maintained by Manufacturing Data Systems Inc. (MDSI)

9. Known Manufacturing Uses: A language used in programming of Numerical Control (N/C) machine tools. At present there are 1400 users of the COMPACT II/ACTION/SPLIT family of languages representing over 6000 N/C machine tools. This results in about 20% of the machine parts made on all N/C tools are programmed in this family of languages.

10. Known Sources of Information:

Robert F. Guise, Jr.
Director - New Product Planning
Manufacturing Data Systems Inc. (MDSI)
320 N. Main St.
Ann Arbor, Michigan 48104

11. Probable Sources of Information:

Mr. Harold Baeverstad
Vice President Manufacturing
Sundstrand Machine Tool Division of the Sundstrand Corp.
Newburg Road
Belvidere, Illinois 61108

Mr. Richard A. Stitt
President
NCCS-WORD, Inc.
23500 Merchantile Blvd.
Cleveland, Ohio 44122

12. Bibliography:

MDSI COMPACT II Programming Manual, March, 1973
Sundstrand Machine Tool OM 3 Omnimill SPLIT Programmers Manual
TS 60030 SPLIT Vocabulary Manual
ACTION Programming Manual for Mill and Drill
ACTION Central, Description of the System
ACTION N/C Time Sharing
5-Axis Action 5A:001

13. Comments: SPLIT is the parent language of a group of languages comprising SPLIT, ACTION, and COMPACT II in a father/son/grandson relationship. The languages are very similar, but the processors are quite different.

It was decided in developing the standard that a standard CL (Cutter Location) Data output would be optional since this family of languages does not necessarily generate an intermediate data output medium.

Approximately 30% to 50% of all N/C machine tools are programmed by computer assist. Of this number approximately 30% to 40% are programmed by COMPACT II/ACTION/SPLIT family of languages. This high use is mainly a result of the efficiency of programming 2 axis machines (lathes, which account for 40% of the N/C tools) and the ease of programming simple parts as compared to the greater programming effort required with the more sophisticated APT language.

CONAPT is a member of this family, not the APT family.

1. Designation: IPAD

2. Title: Integrated Program for Aerospace-Vehicle Design

3. Maintenance Authority:

   Boeing Commercial Aircraft Co.
   P.O. Box 3707
   Seattle, Washington 98124

   NASA Langley Research Center
   Hampton, Virginia

4. Scope: IPAD is not a standard by the common definition. It is an integrated software system to computerize, insofar as possible, company-wide design-information processing. IPAD will be composed of 1) executive software that will control user-directed processes through interactive interfaces with a large number of terminals in simultaneous use by engineering and management personnel, 2) a large number of utility software packages for information manipulation and display functions, and 3) data management software to store, track, and retrieve large quantities of data in multiple storage devices.

   IPAD is scheduled to be released by NASA to become public domain under NASA's For Early Domestic Dissemination (FEDD) policy. If it is widely used by industry IPAD may set de facto standards for data base formats and for the man/machine interfaces.

5. Relationship to Other Standards: N/A

6. Competitive Standards: N/A

7. Standardization Status: N/A

8. Implementation Status: IPAD is now being implemented. It will be released in three stages on two different host computer systems.

Release	1	Host	1	June 1978
"	1	"	2	Dec 1978
"	2	"	1	May 1979
"	2	"	2	Nov 1979
"	3	"	1	June 1980
"	3	"	2	Dec 1980

9. Known Manufacturing Uses: IPAD will be used in aerospace design to provide executive control, data management, and display utilities for engineering and management programs.

10. Known Sources of Information:

    Robert Fulton, or Susan Voigt
    NASA Langley Research Center
    Hampton, Virginia 23665
    804/827-2887, x3401

    R. E. Miller, Jr.
    IPAD Program Manager
    Boeing Commercial Airplane Co.
    P.O. Box 3707
    Seattle, Washington 98124
    206/237-8223

11. Probable Sources of Information: N/A

12. Bibliography:

Feasibility Study on an Integrated Program for Aerospace-Vehicle Design (IPAD), The Boeing Company, Contract NAS1-11441, 1973

Feasibility Study on an Integrated Program for Aerosapce-Vehicle Design (IPAD), General Dynamics/Convair, Contract NAS1-11431, 1973, NASA CR 132401-06.

IPAD Prospectus, NASA Langley Research Center, February 10, 1975.

NASA Request for Proposal 1-15-4934 Development of Integrated Programs for Aerospace-Vehicle Design (IPAD) May 16, 1975.

Boeing Technical Plan-Review D6-IPAD 70002-PS, May 24, 1976.

13. Comments: The Air Force has an memorandum of agreement with NASA to insure the compatability of the IPAD and CAM systems.

1. Designation: Institute for Printed Circuits Standard IPC-D-350A

2. Title: End Product Description in Numeric Form for Printed Wiring Products

3. Maintenance Authority:

   Institute for Printed Circuits
   1717 Howard St.
   Evanston, Illinois 60202

4. Scope: Describes record formats for defining end-product description data in digital form. This digital data, when recorded on punched cards or magnetic tape, contains sufficient information for tooling, manufacturing, and continuity testing of printed wiring products. These formats may be used for transmitting information between the designer and the manufacturing facility when the design has been formed by a computer-aided processes. These formats are also useful when the manufacturing process includes numerically-controlled machines. The data record is not in any particular machine language and can be used for both manual and computer interpretation.

5. Relationship to Other Standards: IPC-D-350A contains the following standards:

   Institute of Printed Circuits:
   - IPC-T-50 Terms and Definitions
   - IPC-D-310 Suggested Guidelines for Artwork Generation and Measurement Techniques for Printed Circuits
   - IPC-D-390 Guidelines for Design Layout and Artwork Generation on Computer Automated Equipment for Printed Wiring

   Department of Defense
   - MIL-STD-429 Printed-Wiring and Printed-Circuit Terms and Definitions

   American National Standards Institute
   - ANSI X3.22 Recorded Magnetic Tape for Information Interchange
   - ANSI X3.26 Hollerith Punched Card Code

   American Society for Testing and Materials
   - E380-74 Metric Practice Guide

6. Competitive Standards: None

7. Standardization Status: IPC-D-350 released August, 1972; IPC-D-350A revised and enhanced, released September, 1975.

   The ANSI Y14.26.2 Subcommittee is presently considering revising IPC-D-350A and reissuing it as a joint ANSI/IPC standard under the designation, ANSI Y14.26.2/IPC-D-350B. This revision will not make any change in the data formats; the only changes will be in the text of the descriptive narrative. Expected release data of this new standard is September, 1976.

8. Implementation Status: Computer-Vision, Inc. has implemented a translator for the standard to sell with their printed wiring manufacturing equipment.

   Bendix and Sandia are negotiating with Applicon for a similar translator.

9. Known Manufacturing Uses: The National Security Agency (NSA) has made IPC-D-350A a requirement for all suppliers of printed circuits and printed circuit equipment.

10. Known Sources of Information:

Timothy Ristine, Chairman of ANSI Y14.26.2/IPC-D-350B
Multiwire-New England
491 Amherst St.
Nashua, N.H. 03060
603/889-0083

11. Probable Sources of Information: N/A

12. Bibliography: N/A

13. Comments:

1. Designation: ANSI Y14.26.1

2. Title: Digital representation of Physical Object Shapes

3. Maintenance Authority:

   American National Standards
   Y14 Committee on Engineering Drawing and Related Documentation

   Subcommittee Y26 on Computer Aided Preparation of Product Definition Data

4. Scope: To establish a standard method of describing physical object shapes to facilitate communication of physical descriptions among computer users.

5. Relationship to Other Standards: Not yet defined. However, the proposed Y14.26.1 standard for a computer-readable format undoubtedly must subsume such currently used standards as MIL-D-1000, Military Specification for Engineering Drawings, and MIL-D-100A, Military Specifications for Engineering Drawing Practices.

   In addition, Y14.26.1 must be compatible with other ANSI Y14, Y10, Y32, and Z32 standards on drafting practices, graphical symbols and letter symbols.

6. Competitive Standards: None

7. Standardization Status: A technical report defining the geometrical foundations of Y14.26.1 was released in June, 1976. A draft of the Y14.26.1 standard will be submitted to the committee for a vote by Spring 1977 and will be released some months thereafter.

8. Implementation Status: N/A

9. Known Manufacturing Uses: Computer aided preparation of engineering drawings.

10. Known Sources of Information:

    S. Hori
    Leader of Y14.26.1 and 2
    McDonnell Douglas Corp.
    Dept. H213, Bldg. 107, Rm. 227
    P.O. Box 516
    St. Louis, MO 63166
    314/232-7286

11. Probable Sources of Information: N/A

12. Bibliography:

    Informational Report on Digital Representation of Physical Object Shapes, American National Technical Report ANSI Y14.26, 1 June, 1976
    Design/Manufacturing Interface, Aerospace Industries Association Report on Project MC 75.4, October, 1975.

13. Comments: This work does not yet represent a formal standard and has had only limited testing. The concepts promise to be extremely useful in constructing and transferring data on geometric objects.

COMPUTER SYSTEMS STANDARDS

1. Designation: EIA RS-232-C, August 1969

2. Title: Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange, August 1969

3. Maintenance Authority: Electronic Industries Association, Subcommittee TR-30.2

4. Scope: Hardware Standard. "This standard is applicable to the interconnection of data terminal equipment (DTE) and data communication equipment (DCE) employing serial binary data interchange." It defines: (1) electrical signal characteristics, (2) interface mechanical characteristics, (3) functional description of interchange circuits, (4) standard interfaces for selected communication system configurations.

5. Relationship to Other Standards:

   EIA RS-334 (ANSI X3.24-1968) Signal quality for EIA 232-C interface
   EIA RS-422 and EIA RS-423, April 1975 (revised electrical signal characteristics)
   EIA SP-1194, October 1975 (revised functional description)

6. Competitive Standards: CCITT V.24 (functional) and V.28 or V.31 for electrical characteristics. CCITT X.21 corresponding interface for public data (in contrast to public telephone) networks.

7. Standardization Status: RS-232, May 1960; RS-232-A, October 1963; RS-232-B, October 1965. RS-232-C is expected to be gradually (ten years) replaced by EIA SP-1194A (see writeup immediately below).

8. Implementation Status: Commerically, RS-232-C has enjoyed universal acceptance as the data terminal-to-modem de facto interface. Although MIL STD 188C prescribes 232-C functions, it employs different (lower voltage and lower impedance) electrical characteristics, primarily for security and privacy purposes.

9. Known Manufacturing Uses: RS-232-C is primarily a communcations (serial) interface specification.

10. Known Sources of Information: Mr. A. M. Wilson, Electronic Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006, (202) 659-2200.

11. Probable Sources of Information: Mr. George E. Clark, National Bureau of Standards, Building 225, Room B210, Washington, D.C. 20234, (301) 921-3723.

12. Bibliography: EIA RS-232-C, August 1969

13. Comments: Equipment conforming to RS-232-C will gradually be replaced with that conforming to RS-422 and 423 (employing integrated circuit components) that will also operate over much greater distances (up to 400 ft.) and at much higher speeds (up to 10 mega bits/sec.). (Note that 232-C is constrained to 20 kilobits/sec and 50 ft.)

1. Designation: EIA SP-1194A/Proposed Federal Standard 1031/Proposed FIPS PUB

2. Title: Functional and Mechanical Interface Between Data Terminal Equipment and Data Communication Equipment

3. Maintenance Authority: Electronic Industries Association Subcommittee TR-30.2.[1]

4. Scope: SP-1194A, together with EIA RS-422 and RS-423, is intended to supersede EIA RS-232-C.

5. Relationship to Other Standards: SP-1194 is presently being revised and may result in two or more standards specifying different interface functional and mechanical characteristics.

6. Competitive Standards:

7. Standardization Status: EIA SP-1194A is presently (September 1976) under EIA ballot. This Standard, together with EIA Standard RS-423, is intended to gradually replace EIA Standard RS-232-C as the specification for the nonengineered interface between data terminal equipment (DTE) and data communication equipment (DCE) employing serial binary data interchange at data signaling rates up to 60,000 bits per second. With a few additional provisions for interoperability, equipment conforming to this standard can interoperate with equipment designed to RS-232-C. This standard is intended primarily for data applications using analog telecommunications networks.

8. Implementation Status: None

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. A. M. Wilson, Electronic Industries Association, (202) 659-2200

11. Probable Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723

12. Bibliography: EIA SP-1194A

13. Comments: A notice of an earlier version (EIA SP-1194) of this standard as a proposed Federal Standard (1031) and a proposed FIPS PUB appeared in the Federal Register on December 5, 1975, page 56938.

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[1] As a Federal Standard, it would be maintained by the National Communications System (NCS-TS), Washington, D.C. 20305.

1. Designation: ANSI X3.24-1968 (EIA RS-334, March 1967)

2. Title: Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission

3. Maintenance Authority: Electronic Industries Association Subcommittee TR-30.1

4. Scope: "This standard is applicable to the exchange of serial binary data signals and timing signals across the interface between data processing terminal equipment and synchronous data communication equipment, as defined in EIA Standard RS-232-C. The data communication equipment is considered to be synchronous if the timing signal circuits are at the transmitting terminal or the receiving terminal, or both . . . This standard does not describe any requirements for error performance, either for a complete system or any system components."

5. Relationship to Other Standards: EIA RS-232-C (the interface)

6. Competitive Standards: None

7. Standardization Status: First approved by EIA in March 1967. Approved as an ANSI Standard on September 27, 1968. Revision of this standard according to the newly approved electrical characteristics is awaiting final EIA actions on recent (July 1976) revisions of EIA Standards RS-422 and 423.

8. Implementation Status: Most equipment conforming to RS-232-C exceeds the provisons of X3.24.

9. Known Manufacturing Uses: Used in conjunction with RS-232-C for specifying the DTE/DCE communications interface.

10. Known Sources of Information: Mr. A. M. Wilson, Electronic Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006, (202) 659-2200

11. Probable Sources of Information: Mr. George E. Clark, National Bureau of Standards, Building, 225, Room B210, Washington, D.C. 20234, (301) 921-3723

12. Bibliography: ANSI X3.24-1968 (EIA RS-334, March 1967)

13. Comments: Conformance to X3.24 assures that the signal amplitude and timing relationships will be compatible for equipment furnished by different suppliers -- and providing that the RS-232-C functions are consistently implemented, this conformance insures that equipment will interoperate.

1. Designation: EIA RS-408

2. Title: Interface Between Numerical Control Equipment and Data Terminal Equipment Employing Parallel Binary Data Interchange

3. Maintenance Authority: EIA EI-31

4. Scope: Hardware Standard. This standard applies to the interconnection of data terminal equipment and numerical control equipment at the tape reader interface. It provides electrical signal characteristics, interface mechanical characteristics, and a functional description of the interface.

5. Relationship to Other Standards: This standard is for parallel-by-bit, serial-by-byte data, such as that generated by a perforated tape reader.

6. Competitive Standards: IEEE Standard 488-1975

7. Standardization Status: Approved by EIA in March 1973

8. Implementation Status: Widely implemented in numerical control equipment.

9. Known Manufacturing Uses: Used in machines employing numerical control.

10. Known Sources of Information: Mr. A. M. Wilson, EIA, (202) 659-2200; Dr. John Evans, NBS, (301) 921-2381.

11. Probable Sources of Information: NMTBA

12. Bibliography: EIA RS-408, March 1973

13. Comments: The data terminal equipment (DTE) typically includes a serial-to-parallel converter. This standard is employed on the parallel-by-bit side of the DTE. Other standards, such as EIA RS-232-C, apply at the serial-by-bit side of the DTE.

1. Designation: IEEE Standard 488-1975

2. Title: IEEE Standard Digital Interface for Programmable Instrumentation

3. Maintenance Authority: IEEE Instrumentation and Measurement Group

4. Scope: Hardware Standard. This standard applies to interface systems used to interconnect both programmable and non-programmable (digital) electronic measuring apparatus with other apparatus and accessories necessary to assemble instrumentation systems. It is a parallel-by-bit, serial-by-byte standard.

5. Relationship to Other Standards: The character coding is based upon ISO 646-1973, similar to ASCII, FIPS PUB 1, ANSI X3.4-1968.

6. Competitive Standards: EIA RS-408, IEEE Standard 583-1975 (CAMAC)

7. Standardization Status: Approved by the IEEE Standards Board on December 19, 1974. Development of this standard was coordinated with IEC/TC66/WG3. It may become an IEC standard.

8. Implementation Status: Implemented in electronic instruments, such as those made by the Hewlett-Packard Co.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. Robert A. Soderman, General Radio Co., (617) 396-4400 x608; Mr. Donald C. Loughry, Hewlett-Packard Co., (408) 735-1550; Mr. Robert G. Fulks, Omnicomp, 71 N. 12th Place, Phoenix, (602) 997-5456.

11. Probable Sources of Information: IEEE

12. Bibliography: IEEE Standard 488-1975

13. Comments: Up to 15 devices may be interconnected on one "party-line" configuration. Cable length is up to 20 meters. Maximum data rate on any signal line is one megabit per second. This standard is optimized for devices in close proximity (up to 20 meters).

1. Designation: IEEE Standard 583-1975

2. Title: IEEE Standard Modular Instrumentation and Digital Interface Systems (CAMAC)[1]

3. Maintenance Authority: IEEE Nuclear Instruments and Detectors Committee

4. Scope: Hardware Standard. "This standard is intended to serve as a basis for a range of modular instrumentation capable of interfacing transducers and other devices to digital controllers for data and control. The standard fully specifies a data bus by means of which instruments and other functional modules can communicate with each other, with peripherals, with computers, and with other external controllers. Data may be transferred either bit-serial or byte-serial."

5. Relationship to Other Standards: Identical in many respects to IEC 482 and IEC 516.

6. Competitive Standards: EIA RS-408, IEEE Standard 488, EIA RS-232-C

7. Standardization Status: Approved by the IEEE Standards Board on February 27, 1975.

8. Implementation Status: Increasingly implemented in laboratory digital instrumentation equipment, especially that related to nuclear physics and testing.

9. Known Manufacturing Uses: Aluminum Furnace Control (ALCOA), Steel Process Control (Inland Steel Co.), Diesel Locomotive Testing (GM), Large Power Semiconductor Testing (GE), Telescope Control and Data Gathering (Kitt Peak)

10. Known Sources of Information: Mr. Dale W. Zobrist, Eldec Corporation, (206) 743-1313; Mr. Louis Costrell, NBS, (301) 921-2518; Mr. Lowell A. Klaisner, Kinetic Systems Corporation, (815) 838-0005

11. Probable Sources of Information: IEEE, ERDA, Stanford Linear Accelerator Center, Lawrence Radiation Lab, Berkeley, California.

12. Bibliography: IEEE Standard 583-1975; "CAMAC, A Modular Standard," IEEE Spectrum, April 1976, pp. 50-55.

13. Comments: This standard was developed by the ESONE Committee of European Laboratories and the NIM Committee of ERDA. Data may be transferred byte-serial for high speeds and bit-serial for long distances.

[1] Computer Automated Measurement and Control

1. Designation: FIPS PUB 22-1 (1976)/ANSI X3.1-1976

2. Title: Synchronous Signaling Rates Between Data Terminal and Data Communication Equipment

3. Maintenance Authority: ANSI X3S36

4. Scope: This standard provides a group of specific signaling rates for synchronous serial or parallel binary data transmission. These rates exist on the received data and transmitted data circuits of the interface between data terminal equipment and data communications equipment which operate over nominal 4kHz voice bandwidth channels.

5. Relationship to Other Standards: FIPS PUB 37/ANSI X3.36-1975 (wide band synchronous signaling rates); EIA RS-334 is referenced by ANSI X3.1 for tolerances on the prescribed rates.

6. Competitive Standards: None

7. Standardization Status: First approved by ANSI in 1962 and revised slightly in 1966, 1969, and 1976. The most recent revision (1976) eliminated the "interim-speed of 2000 bits/second."

8. Implementation Status: FIPS PUB 22-1 differs from X3.1 only in that it specifies the tolerance as follows: "The deviation from any specified rate shall not exceed 0.01 percent."

9. Known Manufacturing Uses: Applicable to data terminal and data processing equipment employed with synchronous data communication designed to operate on binary encoded information over voice grade lines.

10. Known Sources of Information: Mr. William F. Hanrahan, Secretary, ANSI X3, (202) 466-2288; H. J. Crowley, Chairman X3S36, (315) 330-2355

11. Probable Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723

12. Bibliography: FIPS PUB 22-1 (1976)/ANSI X3.1-1976

13. Comments: None

1. Designation: FIPS PUB 16-1971/ANSI X3.15-1966

2. Title: Bit Sequencing of ASCII in Serial-by-Bit Data Transmission

3. Maintenance Authority: NBS/ANSI X3S33

4. Scope: This standard specifies the bit sequencing of ASCII (ANSI X3.4-1968) for serial-by-bit, serial-by-character data transmission. It applies at the interface between data processing terminal equipment and data communications equipment.

5. Relationship to Other Standards: This is an implementation standard for CCITT Recommendation V.4-1972 and for ASCII (FIPS PUB 1, ANSI X3.4-1968) and the character structure standards for serial-by-bit data (FIPS PUB 17, ANSI X3.16-1966). EIA RS-232-C uses this standard.

6. Competitive Standards: All bit-oriented, code-independent data transmission standards, such as HDLC, SDLC, ADCCP, BDLC, etc; parallel-by-bit standards, such as FIPS PUB 18, ANSI X3.25-1968.

7. Standardization Status: Approved as an ANSI standard on August 19, 1966. FIPS PUB 16 adopted RS-232-C and ASCII (FIPS PUB 1, ANSI X3.4-1968).

8. Implementation Status: Widely implemented in terminal equipment conforming to EIA standard RS-232-C and ASCII (FIPS PUB 1, ANSI X3.4-1968).

9. Known Manufacturing Uses: Virtually all ASCII data transmitted in serial-by-bit, serial-by-character form, conforms to the conventions of this standard.

10. Known Sources of Information: Mr. John L. Little, NBS, (301) 921-3723; Mr. William F. Hanrahan, Secretary of ANSI X3, (202) 466-2288.

11. Probable Sources of Information: Teletype Corporation

12. Bibliography: FIPS PUB 16-1971, ANSI X3.15-1966. CCITT "Green Book," Vol. VIII, Recommendation V.4 on pp. 61-62, 1973.

13. Comments: This standard specifies that the ASCII bits for each character be transmitted low-order bit (b1) first. Character-oriented data, such as decimal digits, are usually transmitted high-order character first, and are stored in computer memories with the high-order characters at the high order end of words or blocks. Hence, each character transmitted according to this standard may be subjected to bit inversion for transmission and further bit inversion for re-assembly of a computer-oriented character stream or data structure. For this reason, IBM and others opposed this standard, which was a highly controversial proposal until it was approved in 1966.

1. Designation: FIPS PUB 17-1971/ANSI X3.16-1966

2. Title: Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in ASCII (FIPS PUB 1/ANSI X3.4-1968)

3. Maintenance Authority: NBS/ANSI X3S33

4. Scope: Hardware Standard. This standard specifies the character structure and sense of character parity for serial-by-bit, serial-by-character synchronous and asynchronous data communication in ASCII (FIPS PUB 1, ANSI X3.4-1968). This standard applies to general information interchange at the interface between data processing terminal equipment and the data communication equipment.

5. Relationship to Other Standards: This standard is an implementation of the 7-bit code of ASCII (FIPS PUB 1/ANSI X3.4-1968). It is used at interfaces such as EIA RS-232-C. The companion standard FIPS PUB 18/ANSI X3.25-1968 is for character structures using parallel-by-bit data communication. Subsets, such as EIA RS-358, can use the structure of this standard.

6. Competitive Standards: Proprietary structures for communicating non-ASCII codes, such as 6-bit Teletypesetter or 8-bit EBCDIC

7. Standardization Status: The ANSI standard X3.16 was approved on August 19, 1966; FIPS PUB 17, adopting in its entirety that ANSI standard, was approved on October 1, 1971.

8. Implementation Status: Widely implemented in communication systems and ADP terminal devices.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. John L. Little, NBS, (301) 921-3723; Mr. George E. Clark, NBS, (301) 921-3723.

11. Probable Sources of Information: Teletype Corporation

12. Bibliography: FIPS PUB 17-1971/ANSI X3.16-1966

13. Comments: This standard specifies odd parity for synchronous data communication and even parity for asynchronous data communication. It does not specify the bit sequence, which is given in FIPS PUB 16/ANSI X3.15-1966.

1. Designation: FIPS PUB 18-1971/ANSI X3.25-1968

2. Title: Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in ASCII (FIPS PUB 1/ANSI X3.4-1968)

3. Maintenance Authority: NBS/ANSI X3S33

4. Scope: Hardware Standard. This standard specifies the character structure and sense of character parity for parallel-by-bit, serial-by-character, data communication in ASCII (FIPS PUB 1/ANSI X3.4-1968). This standard applies to general information interchange at the interface between data processing terminal equipment and data communication equipment.

5. Relationship to Other Standards: This standard is an implementation of the 7-bit code for ASCII (FIPS PUB 1/ANSI X3.4-1968). It is used at parallel-by-bit interfaces, such as EIA RS-408. The companion standard FIPS PUB 17/ANSI X3.16-1966 is for character structures using serial-by-bit data communication. Subsets, such as EIA RS-358 can use the structure of this standard.

6. Competitive Standards: Proprietary incompatible structures for communicating non-ASCII codes, such as 8-bit EBCDIC.

7. Standardization Status: The ANSI standard X3.25 was approved on September 27, 1968; FIPS PUB 18, adopting in its entirety that ANSI standard, was approved on October 1, 1971.

8. Implementation Status: Implemented in most parallel-by-bit data communication devices.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723; Mr. John L. Little, NBS, (301) 921-3723.

11. Probable Sources of Information:

12. Bibliography: FIPS PUB 18-1971, ANSI X3.25-1968

13. Comments: This standard specifies an 8-bit character structure including the 7 bits of ASCII and an odd parity bit where the character timing is not separately signaled. Where the character timing is on a separate timing channel, the parity sense is even.

1. Designation: FIPS PUB 37 (1975)/FED-STD-1001/ANSI X3.36-1975

2. Title: Synchronous High Speed Data Signaling Rates Between Data Terminal Equipment and Data Communication Equipment

3. Maintenance Authority: ANSI X3S36

4. Scope: "This standard provides a group of specific signaling rates for synchronous high speed serial data transfer. These rates exist on the received data and the transmitted data circuits of the interface between data terminal equipment and data communication equipment that operate over high speed channels."

5. Relationship to Other Standards: FIPS PUB 22-1 (1976)/ANSI X3.1-1976

6. Competitive Standards: None

7. Standardization Status: The Federal standard (FED-STD-1001) adopts the ANSI standard (X3.36) with two exceptions, as follows: "a. The note alluding to certain unspecified coding restrictions on the data stream of users operating at 1544 kbits/sec is not applicable," and "b. A signaling rate of 64 kbit/sec may also be utilized by Federal agencies having requirements to interface directly with point-to-point transmission facilities of foreign communication carriers."

8. Implementation Status:

9. Known Manufacturing Uses: None

10. Known Sources of Information: Mr. William F. Hanrahan, Secretary, ANSI X3, (202) 466-2288; H. J. Crowley, Chairman X3S36, (315) 330-2355

11. Probable Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723

12. Bibliography: FIPS PUB 37 (1975)/FED-STD-1001/ANSI X3.36-1975

13. Comments: ATT has only recently applied for a tariff (#269) proposing to offer the rates prescribed by this standard as part of the Dataphone Switched Digital Service (DSDS). This tariff is based on 56 kbit/sec subscriber services. This and other speeds prescribed by X3.36 are not presently in wide usage.

1. Designation: FED-STD-1020/EIA RS-422 (1975)

2. Title: Electrical Characteristics of Balanced Voltage Digital Interface Circuits

3. Maintenance Authority: Electronic Industries Association Committee TR-30.1

4. Scope: This standard specifies the electrical characteristics of the balanced voltage digital interface circuit, normally implemented in integrated circuit technology, that may be employed for the interchange of serial binary signals between data terminal and data communication equipment.

5. Relationship to Other Standards: FED-STD-1030/EIA RS-423 (Unbalanced Voltage Digital Interface Circuits); EIA RS-232-C (only the electrical characteristics).

6. Competitive Standards: None

7. Standardization Status: RS-422 (and also RS-423) may be employed as an evolutiontary replacement for the electrical characteristics of RS-232-C.

8. Implementation Status: Not widely implemented at present.

9. Known Manufacturing Uses: Although primarily designed for communication interface applications, the integrated circuit components implementing RS-422 can be employed in many other data interchange environments.

10. Known Sources of Information: Mr. A. M. Wilson, Electronic Industries Association, (202) 659-2200

11. Probable Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723

12. Bibliography: FED-STD-1020/EIA RS-422 (1975)

13. Comments: None

1. Designation: FED-STD-1030/EIA RS-423 (1975)

2. Title: Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits

3. Maintenance Authority: Electronic Industries Association Committee TR-30.1

4. Scope: This standard specifies the electrical characteristics of the unbalanced voltage digital interface circuit, normally implemented in integrated circuit technology, that may be employed for the interchange of serial binary signals between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE).

5. Relationship to Other Standards: FED-STD-1020/EIA RS-422 (Balanced Voltage Digital Interface Circuits); EIA RS-232-C (only the electrical characteristics)

6. Competitive Standards: None

7. Standardization Status: RS-423 (and also RS-422) may be employed as an evolutionary replacement for the electrical characteristics of RS-232-C.

8. Implementation Status: Not widely implemented at present.

9. Known Manufacturing Uses: Although primarily designed for communication interface applications, the integrated circuit components implementing RS-423 can be employed in many other data interchange environments.

10. Known Sources of Information: Mr. A. M. Wilson, Electronic Industries Association, (202) 659-2200

11. Probable Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723

12. Bibliography: FED-STD-1030/EIA RS-423 (1975)

13. Comments: None

1. Designation: C.C.I.T.T. Recommendation V.28

2. Title: Electrical Characteristics for Unbalanced Double-Current Interchange Circuits

3. Maintenance Authority: C.C.I.T.T.

4. Scope: Hardware Standard. "The electrical characteristics specified in this Recommendation apply generally to interchange circuits operating with data signalling rates below the limit of 20,000 bits per second."

5. Relationship to Other Standards: C.C.I.T.T. Recommendation V.31 is for the lower speed circuits up to 75 bits per second.

6. Competitive Standards: C.C.I.T.T. V.28 is an alternative to the electrical characteristics of EIA RS-232-C.

7. Standardization Status: Approved by the C.C.I.T.T. plenary session at Geneva, Switzerland in 1972.

8. Implementation Status: Implemented primarily in Europe.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. Ira W. Cotton, NBS, (301) 921-2601; Mr. George E. Clark, NBS, (301) 921-3723; Mr. Arthur Freeman, U.S. Dept. of State, (202) 632-1007

11. Probable Sources of Information: Teletype Corporation

12. Bibliography: C.C.I.T.T. Recommendation V.28, "Green Book," Vol. VIII, Data Transmission, pp. 132-135.

13. Comments: C.C.I.T.T. is the French abbreviation for International Consultative Committee on Telegraph and Telephone. In most nations of the world (but not in the U.S.), its recommendations are given the force of law. The U.S. is represented on the CCITT by the U.S. Department of State. By way of contrast, the U.S. is represented on ISO and IEC by ANSI. The CCITT is an organ of the International Telecommunications Union (ITU) which is reported to be the oldest international standardizing body in the world. The ITU is now an organ of the United Nations.

1. Designation: C.C.I.T.T. Recommendation V.31

2. Title: Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure

3. Maintenance Authority: C.C.I.T.T.

4. Scope: Hardware Standard. "In general, the electrical characteristics specified in this Recommendation apply to interchange circuits operating at data signalling rates up to 75 bits per second."

5. Relationship to Other Standards: C.C.I.T.T. Recommendation V.28 is for higher speed circuits up to 20,000 bits per second.

6. Competitive Standards:

7. Standardization Status: Approved by the CCITT plenary session at Geneva, Switzerland, in 1972.

8. Implementation Status: Implemented primarily in Europe.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. Ira W. Cotton, NBS, (301) 921-2601; Mr. George E. Clark NBS, (301) 921-3723; Mr. Arthur Freeman, U.S. Department of State, (202) 632-1007

11. Probable Sources of Information: Teletype Corporation

12. Bibliography: C.C.I.T.T. Recommendation V.31, "Green Book," Vol. VIII, Data Transmission, pp. 140-142

13. Comments: C.C.I.T.T. is the French abbreviation for International Consultative Committee on Telegraph and Telephone. In most nations of the world (but not in the U.S.), its recommendations are given the force of law. The U.S. is represented on the CCITT by the U.S. Department of State. By way of contrast, the U.S. is represented on ISO and IEC by ANSI. The CCITT is an organ of the International Telecommunications Union (ITU) which is reported to be the oldest international standardizing body in the world. The ITU is now an organ of the United Nations.

1. Designation: Fourth Draft Proposed Standard "ANSI X.21" (Document No. X3S37-75-54/4)

2. Title: General Purpose Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment for Synchronous Operation on Public Data Networks

3. Maintenance Authority: ANSI Task Group X3S37

4. Scope: This standard defines the interface characteristics, interface procedures and timing of events, signal formats, and failure detection and isolation for a general purpose interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE) for synchronous operation on public data networks.

5. Relationship to Other Standards: (1) Essentially the same as CCITT Recommendation X.21. (2) An alternative to EIA Standards RS-232-C and RS-XYZ that are both intended for DTE interconnections to analog network facilities. (3) A portion of CCITT Recommendation X.25 on packet switching.

6. Competitive Standards: See 5. (2) above.

7. Standardization Status: Fourth draft completed by X3S37 as a result of a letter ballot. This draft will probably be forwarded to X3.

8. Implementation Status: None

9. Known Manufacturing Uses: None

10. Known Sources of Information: Mr. George E. Clark, Jr., NBS (301) 921-3723 and Mr. J. G. Griffis, DCA (703) 437-2247.

11. Probable Sources of Information: Mr. S. M. Harris, Mitre Corporation (617) 271-3587; Mr. B. D. Wessler, Telenet Communications Corporation (202) 637-7925; and Mr. Vincent Dovydaitis, AFCS/LO (617) 861-4801.

12. Bibliography: None

13. Comments: Telephone systems in the future will be based on digital transmission systems. A/D and D/A converters will be placed in the hardset. A 4000HZ audio bandwidth will be achieved by digitizing at an 8KHZ sampling rate with 7 bits resolution. This means that each phone will use a 56 Kbit digital line. X.21 is the appropriate DTE/DCE protocol for such a transmission system. Limited implementation now; widespread implementation in the 1980's.

1. Designation: Draft Proposed Standard ANSI X3T92/064

2. Title: Class B Device Level Interface (for minicomputer systems)

3. Maintenance Authority: ANSI X3T92

4. Scope: These specifications define an interconnection between a peripheral device and a controller in which:
   - The data exchanged between interconnected defices is digital.
   - The number of devices interconnected via the interface is limited to four.
   - The total transmission path length of the interconnecting cables does not exceed 100 feet (30 meters).
   - The data rate across the interface does not exceed the maximum rate designated for each device class.

5. Relationship to Other Standards: None

6. Competitive Standards: None

7. Standardization Status: Draft proposed standard has not yet been completed by the Task Group to include electrical characteristics and device specifications.

8. Implementation Status: Similar to PERTEC magnetic tape drive interface.

9. Known Manufacturing Uses: None

10. Known Sources of Information: Mr. George E. Clark, Jr., NBS (301) 921-3723 and Mr. J. M. Bakshi, NBS (301) 921-3723.

11. Probable Sources of Information: Mr. Delbert Showmaker, GSA (202) 566-1180 and Mr. G. S. Robinson, Inforex, Inc. (617) 272-6470.

12. Bibliography:

13. Comments:

1. Designation: Draft Proposed Standard ANSI X3T9/600, Revision 2

2. Title: Working Paper for a Draft Proposed American National Standard for I/O Channel Interface

3. Maintenance Authority: ANSI X3T9

4. Scope: This American National Standard specifies functional, electrical, and mechanical characteristics of the interface between I/O control units and channels in general purpose computer systems.

5. Relationship to Other Standards: None

6. Competitive Standards: None

7. Standardization Status: Draft proposed standard (revision 2) has been revised to reflect results of X3T9 letter ballot and has been forwarded to X3.

8. Implementation Status: Implemented by Amdahl, Itel, and IBM central processors and in the I/O controllers built by STC, Telex, and other independent peripheral suppliers.

9. Known Manufacturing Uses: None

10. Known Sources of Information: Mr. George E. Clark, Jr., NBS (301) 921-3723 and Mr. J. M. Bakshi, NBS (301) 921-3723.

11. Probable Sources of Information: Mr. Delbert Showmaker, GSA (202) 566-1180 and Mr. Richard Guyette, IBM (914) 463-8153.

12. Bibliography: None

13. Comments: None

1. Designation: FIPS PUB 1-1968/ANSI X3.4-1968 (ASCII)[1]

2. Title: American National Standard Code for Information Interchange

3. Maintenance Authority: ANSI X3L2

4. Scope: Hardware Standard. "This coded character set is to be used for the general interchange of information among information processing systems, communication systems, and associated equipment."

5. Relationship to Other Standards:

   ISO 646-1973, (dialect)
   CCITT V.3-1972 (dialect)
   FIPS PUB 2-1968/ANSI X3.6-1965 (implementation, perforated tape)
   FIPS PUB 3-1, 1973/ANSI X3.22-1973 (implementation, magnetic tape, 800 cpi)
   FIPS PUB 7-1969 (implementation instructions, Presidential memo)
   FIPS PUB 14-1971/ANSI X3.26-1970 (implementation, Hollerith punched card)
   FIPS PUB 15-1971 (subsets: 95, 64, 16 graphic characters)
   FIPS PUB 16-1971/ANSI X3.15-1966 (implementation, bit sequencing)
   FIPS PUB 17-1971/ANSI X3.16-1966 (implementation, character structure, serial)
   FIPS PUB 18-1971/ANSI X3.25-1968 (implementation, character structure, parallel)
   FIPS PUB 25-1973/ANSI X3.39-1973 (implementation, magnetic tape, 1600 cpi)
   FIPS PUB 35-1975/ANSI X3.41-1974 (code extension, 7 or 8 bits)
   FIPS PUB 36-1975/ANSI X3.32-1973 (graphical representation of controls)
   ANSI X3.14-1973 (implementation, magnetic tape, 200 cpi)
   ANSI X3.28-1971 (implementation, communication control characters)
   ANSI Z39.2-1971 (superset, magnetic tape, bibliographic interchange)
   EIA RS-358 (1968) (subset, numerical machine control)
   ECMA-6 (dialect)

6. Competitive Standards: EBCDIC, FIELDATA, TELETYPESETTER, CORRESPONDENCE Code (Some IBM Selectric Typewriter Terminals), EIA RS-RS-244A, and all other coded character sets in use prior to 1963.

7. Standardization Status: First approved in 1963. Revised in a major sense in 1967, with a further minor revision in 1968 into the standard now in effect. Another minor revision is expected in 1977.

8. Implementation Status: ASCII is the most widely implemented code in ADP terminals and in communication systems. It is implemented as the internal code of most minicomputers and microprocessors, all DEC computers, NCR Century and Criterion computers, and the newer large UNIVAC computers and many European computers. It would be more widely implemented in American computers except for the severe competition from EBCDIC in IBM 360, 370, and other computers compatible therewith.

9. Known Manufacturing Uses: Data and message communications; direct numerical control (EIA RS-358 subset); code used in minicomputers and microprocessors.

10. Known Sources of Information: Mr. Charles D. Card, UNIVAC, Chairman of ANSI X3L2, (215) 542-3675; Mr. John L. Little, NBS, member of ANSI X3L2, (301) 921-3723; Mr. William F. Hanrahan, Secretary of ANSI X3, (202) 466-2288

11. Probable Sources of Information: DEC, NCR, Honeywell, Teletype Corporation

12. Bibliography: FIPS PUB 1-1968/ANSI X3.4-1968 (base standard); FIPS PUB 7-1969 (implementation instructions); FIPS PUB 35-1975/ANSI X3.41-1974 (extension in 7 or 8 bits); Western Union Technical Bulletin 71-1, "The ASCII Codes (1963, 1967, and 1968 Versions)."

13. Comments: ASCII is a fundamental standard upon which many other hardware and software standards are based. It has counterparts in international and Federal standards, as well as in many foreign national standards.

[1] The standard also allows the abbreviation "USASCII," but ASCII is much more prevalent.

1. Designation: ISO 646-1973

2. Title: Seven-Bit Coded Character for Information Processing Interchange

3. Maintenance Authority: ISO/TC97/SC2

4. Scope: Hardware Standard. "This character set (of 128 characters) is primarily intended for the interchange of information among data processing systems and associated equipment, and within message transmission systems. This character set is applicable to all Latin alphabets."

5. Relationship to Other Standards: CCITT Recommendation V.3-1972 is essentially identical to this standard. Similar to ASCII (ANSI X3.4-1968) and the national standards of many other countries, e.g., GOST 13052-1967 (USSR). Similar to ECMA-6, ISO 2022-1973 (extension in 7 or 8 bits).

6. Competitive Standards: EBCDIC in IBM 360, 370 computers, and all coded character sets that were in use prior to 1963.

7. Standardization Status: First approved in December 1967 as 6 and 7-bit coded character sets. The 6-bit set was derived from an ECMA 6-bit code and the 7-bit one was derived from ASCII (X3.4-1967), each of which influenced the other. The current 1973 version relegates the 6-bit set to an appendix which is no longer part of the standard. The 1973 standard contains a "Basic Code Table" and an "International Reference Version" (IRV). The basic code table allows national options while the IRV does not.

8. Implementation Status: CCITT Recommendation V.3-1968 is identical to this standard except for a few restrictions governing international communication. National implementations, such as ASCII (ANSI X3.4-1968) can be considered implementations of this standard.

9. Known Manufacturing Uses: A subset of this standard, in EIA RS-358 (1968), is used as a perforated tape code for numerical control of machine tools.

10. Known Sources of Information: Mr. John L. Little, NBS, (301) 921-3723; Mr. Robert M. Brown, CBEMA, (202) 466-2288.

11. Probable Sources of Information: IBM, Sperry UNIVAC, Honeywell, DEC, NCR, Teletype Corporation

12. Bibliography: ISO 646-1973, available from ANSI.

13. Comments: Extension techniques for this basic code are given in ISO 2022-1973. A draft "ISO International Register of Character Sets to be used with Escape Sequences for Information Interchange in Data Processing" is published in document ISO/TC97/SC2 N1000, maintained by AFNOR in Paris, France.

1. Designation: CCITT V.3-1972

2. Title: International Alphabet No. 5

3. Maintenance Authority: CCITT

4. Scope: Hardware Standard. "This character set (of 128 characters) is primarily intended for the interchange of information among data processing systems and associated equipment, and within message transmission systems. This character set is applicable to all Latin alphabets."

5. Relationship to Other Standards: ISO 646-1973 is essentially identical to this standard. This standard is similar to ASCII (ANSI X3.4-1968) and to the national standards of many other countries, as well as to ECMA-6. See FIPS PUB1.

6. Competitive Standards: EBCDIC in IBM 360, 370 computers, and all coded character sets in use prior to 1963.

7. Standardization Status: First approved in 1968 at the CCITT plenary session at Mar del Plata, Argentina, and amended in 1972 at Geneva.

8. Implementation Status: National implementations, such as ASCII (ANSI X3.4-1968) can be considered implementations of this standard. It is implemented in many international communication networks.

9. Known Manufacturing Uses: A subset of this standard, in EIA RS-358 (1968), is used as a perforated tape code for numerical control of machine tools.

10. Known Sources of Information: Mr. Ira W. Cotton, NBS, (301) 921-2601; Mr. Arthur Freeman, U.S. Department of State, (202) 632-1007.

11. Probable Sources of Information: Teletype Corporation, ITT, RCA, Western Union

12. Bibliography: The International Telegraph and Telephone Consultative Committee (C.C.I.T.T.) Fifth Plenary Assembly, Geneva, 4-15 December 1972, "Green Book" Vol. VIII, Data Transmission, published by the International Telecommunications Union, 1973.

13. Comments: This standard was developed jointly with ISO 646-1973 and is virtually identical to that standard. C.C.I.T.T. is the French abbreviation for International Consultative Committee on Telegraph and Telephone. In most nations of the world (but not the U.S.A.), its recommendations are given the force of law. The U.S. is represented on the CCITT by the U.S. Department of State. By way of contrast, the U.S. is represented on ISO and IEC by ANSI. The CCITT is an organ of the International Telecommunications Union (ITU) which is reported to be the oldest international standardizing body in the world. The ITU is now an organ of the United Nations.

1. Designation: IBM CSS 3-3220-002, EBCDIC[1]

2. Title: Extended Binary Coded Decimal Interchange Code (LATIN ALPHABETS)

3. Maintenance Authority: IBM Systems Standards Department, Poughkeepsie, New York

4. Scope: "This standard defines for the IBM Corporation the BCD coded representation for up to 256 graphics and controls in punched cards, in magnetic tape, on data transmission lines, and in 8-bit BCD CPU's. It also defines a collating sequence."

5. Relationship to Other Standards: This is a commercial standard. In 1970 IBM distributed copies through the European Computer Manufacturers Association (ECMA) and encouraged its adoption as a standard. No formal recognition has been granted to EBCDIC as a national or international standard. It is used in various forms by some other computer vendors who wish to provide easy transition from IBM products to competitive ones.

6. Competitive Standards: ISO 646-1973, CCITT V.3-1972, ANSI X3.4-1968 (ASCII), FIELDATA, TELETYPESETTER.

7. Standardization Status: None, except as an IBM corporate systems standard.

8. Implementation Status: Implemented in IBM 360 and 370, System 3, System 32 computers, Amdahl computers and with variations in certain Burroughs, Honeywell and Univac (RCA) computers. Used in the RYAD series of computers built in the Soviet bloc countries in order to provide compatibility with IBM.

9. Known Manufacturing Uses: Used in IBM computer-aided design systems.

10. Known Sources of Information: Mr. Hubert F. Ickes, IBM, (914) 463-9779; Mr. Robert H. Follett, IBM, (301) 897-3471; Mr. John L. Little, NBS, (301) 921-3723.

11. Probable Sources of Information: Mr. Robert M. Brown, Vice Chairman of ANSI X3, CBEMA, (202) 466-2288.

12. Bibliography: IBM Corporate Systems Standard CSS 3-3220-002, November 1970, Extended BCD Interchange Code, Latin Alphabets. IBM System 370, Principles of Operation, GA 22-7000-4, File No. S/370-01, Appendix H.

13. Comments: Representation of the 128 ASCII characters in EBCDIC coding is shown in an Appendix (not part of the standard) to the Hollerith Punched Card Code, ANSI X3.26-1970 (FIPS PUB 14).

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[1] Supersedes IBM CSS 2-8015-002, EBCDIC.

1. Designation: Encryption Algorithm

2. Title: Encryption Algorithm for Computer Data Protection

3. Maintenance Authority: U.S. Department of Commerce, NBS

4. Scope: This algorithm is designed to encipher and decipher blocks of data consisting of 64 bits under control of a 64-bit key.

5. Relationship to Other Standards: Identical to an IBM encryption algorithm.

6. Competitive Standards: None

7. Standardization Status: Published as a proposed Federal standard in the Federal Register, Vol. 40, No. 52, March 17, 1975, pp. 12134-12139.

8. Implementation Status: Implemented in IBM encryption/decryption equipment, and in integrated circuit chips supplied by several vendors.

9. Known Manufacturing Uses: IBM, NSA.

10. Known Sources of Information: Dr. Dennis K. Branstad, NBS, (301) 921-3861.

11. Probable Sources of Information: IBM, NSA.

12. Bibliography: Federal Register, Vol. 40, No. 52, March 17, 1975, pp. 12134-12139. U.S. Patent Nos. 3,796,830 and 3,798,359.

13. Comments: The Federal standard is identical to an IBM algorithm. IBM will grant a royalty-free license, as stated in the Federal Register cited above.

1. Designation: EIA RS-358 (1968)/ISO 840-1973

2. Title: Subset of USA Standard Code for Information Interchange (ASCII) for Numerical Machine Control Perforated Tape

3. Maintenance Authority: EIA EI-31

4. Scope: Hardware Standard. "This standard describes a subset of USAS X3.4-1967 (ANSI X3.4-1968) for numerically controlled machines and associated perforated tape preparation equipment."

5. Relationship to Other Standards: ANSI X3.4-1968 (base); FIPS PUB 2-1968/ANSI X3.6-1965 (implementation, perforated tape). ISO 840-1973 is the same coding. ISO 1113 is a compatible implementation in perforated tape.

6. Competitive Standards: EIA RS-244A-1967

7. Standardization Status: Approved by EIA in July 1968

8. Implementation Status: Implemented in all newer numerically-controlled machine tools. Some have a switch that allows either this standard or RS-244A coding to be used in the same machine.

9. Known Manufacturing Uses: Widely used as the perforated tape coding for numerically controlled machine tools.

10. Known Sources of Information: Mr. A. M. Wilson, EIA, (202) 659-2200; Mr. John L. Little, NBS, (301) 921-3723.

11. Probable Sources of Information: NMTBA

12. Bibliography: EIA RS-358, EIA RS-244A, ISO 840, ISO 1113

13. Comments: The original perforated tape code standard for numerical control was approved in July 1961 (before ASCII) as EIA RS-244, a BCD coding as used in Flexowriters. A revision, RS-244A was approved in January 1967 and the conflicting RS-358 was approved in July 1968. RS-244A will be rescinded in order to resolve the conflict. The character sets of EIA RS-244A and RS-358 are the same, but the coding is very different.

1. Designation: EIA RS-274-C

2. Title: Interchangeable Perforated Tape Variable Block Format for Positioning, Contouring and Contouring/Positioning Numerically Controlled Machines.

3. Maintenance Authority: EIA EI-31

4. Scope: This standard applies wherever a variable block format is used on perforated tape to control numerically controlled machines.

5. Relationship to Other Standards: This standard has replaced EIA RS-273-B (rescinded), variable block for positioning and straight cut, EIA RS-326-A (rescinded), fixed block for positioning and straight cut, and EIA RS-274-B, variable block for contouring and contouring/positioning. It may in turn be superseded by EIA SP-1177A, command and data format for advanced contouring and positioning.

6. Competitive Standards:

7. Standardization Status: RS-274 was approved in January 1963. It became ANSI standard X3.8-1965. RS-274-A was a revision and RS-274-B became ANSI standard X8.2-1968. RS-274-C was approved (SP-1147) in April 1974.

8. Implementation Status: Widely implemented in numerical control equipment.

9. Known Manufacturing Uses: Widely used in production where numerical control is involved.

10. Known Sources of Information: Mr. A. M. Wilson, EIA, (202) 659-2200; Dr. John M. Evans, Jr., NBS, (301) 921-2381

11. Probable Sources of Information: NMTBA

12. Bibliography: EIA RS-274-C

13. Comments: This was formerly known as EIA Standards Proposal No. 1147 (SP-1147), March 13, 1973. RS-274-C may be superseded by EIA SP-1177A.

1. Designation: EIA SP-1177A (a proposal currently under revision)

2. Title: Recommended Command and Data Format for Advanced Contouring and Positioning Numerically Controlled Machines

3. Maintenance Authority: EIA EI-31

4. Scope: Hardware Standard. "This standard is intended to serve as a guide in the coordination of system design to promote uniformity in part programming and operating techniques for inputting extended machine set-up, initialization, and/or operational parameter data."

5. Relationship to Other Standards: Machine program data are formatted in accordance with EIA RS-274-C. This standard, when approved, will supersede EIA Automation Bulletin No. 4, March 1969. It will also probably supersede EIA RS-274-C, which in turn superseded RS-273-A, RS-274-B, and RS-326.

6. Competitive Standards:

7. Standardization Status: This revision of SP-1177 was circulated for EIA ballot on April 23, 1975.

8. Implementation Status: Used in all new US computer numerical control (CNC) equipment.

9. Known Manufacturing Uses: Will be widely used in production where CNC is involved.

10. Known Sources of Information: Mr. A. M. Wilson, EIA, (202) 659-2200; Dr. John M. Evans, Jr., NBS, (301) 921-2381.

11. Probable Sources of Information: NMTBA

12. Bibliography: EIA Standards Proposal No. 1177-A (Revision of SP-1177), April 23, 1975.

13. Comments: This SP-1177A will become an EIA Recommended Standard (RS) when the various points of view and controversy are resolved. SP-1177A contains three key concepts: the overall architecture of an NC system, specially identifying interfaces to external components; an escape code to go from RS-358 to full ASCII ("type 1 and type 2 data"); and phonetic abbreviations for CNC control functions. The proposed standard is essentially a guideline for the development of advanced systems by NC control manufacturers.

1. Designation: FIPS PUB 36-1975/ANSI X3.32-1973

2. Title: Graphic Representation of the Control Characters of ASCII

3. Maintenance Authority: NBS/ANSI X3L2

4. Scope: Hardware Standard. This standard provides a graphic representation of the control characters of ASCII, including SPACE and DELETE. The standard contains two alternative sets of representations: a pictorial representation and an alphanumeric representation.

5. Relationship to Other Standards: Gives single or dual symbol representation of the 32 controls as well as SPACE and DELETE of the ASCII code standard, FIPS PUB 1/ANSI X3.4-1968.

6. Competitive Standards: None

7. Standardization Status: The ANSI standard X3.32-1973 was first approved on July 3, 1973. FIPS PUB 36, adopting the ANSI standard in its entirety, was approved on June 1, 1975.

8. Implementation Status: Has been implemented on paper tape equipment that prints one symbol per tape character frame. Has also been implemented in some display terminals to display character streams, including controls. See comments below.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. C. D. Card, UNIVAC, Chairman ANSI X3L2, (215) 542-3675; Mr. John L. Little, NBS, (301) 921-3723; Mr. Robert M. Brown, Vice Chairman of ANSI X3, CBEMA, (202) 466-2288.

11. Probable Sources of Information: Honeywell, Teletype Corporation, Omron.

12. Bibliography: FIPS PUB 36, ANSI X3.32-1973

13. Comments: Implemented (except for the Backspace character representation) in Teletype Model 40 display/printing terminals. Implemented (except for the NULL character representation) in Omron Model 8025 keyboard display terminals.

1. Designation: FIPS PUB 14/ANSI X3.26-1970

2. Title: Hollerith Punched Card Code

3. Maintenance Authority: ANSI X3L2

4. Scope: Hardware Standard. This standard specifies 256 hole patterns in twelve-row punched cards. Hole patterns are assigned to the 128 characters of ASCII (FIPS PUB 1/ANSI X3.4-1968).

5. Relationship to Other Standards: This standard gives the implementation of FIPS PUB 1/ANSI X3.4-1968 (ASCII) in twelve-row punched cards. FIPS PUB 13/ANSI X3.21-1967, Rectangular Holes in Twelve-Row Punched Cards, gives dimensions and dimensional tolerances of the cards and holes. ANSI X3.11-1969, Specifications for General Purpose Paper Cards for Information Processing, gives properties of the card stock.

6. Competitive Standards: The round hole "90 column" cards formerly marketed by UNIVAC are obsolete. The 96-column round hole cards introduced with the IBM System 3 are not compatible with this standard.

7. Standardization Status: FIPS PUBs 13 and 14 were both approved on October 1, 1971. ANSI Standard X3.21-1967 was first approved in 1967. ANSI Standard X3.26-1970 was first approved in 1970.

8. Implementation Status: These standards are widely implemented in punched card accounting machines and as input media for computers.

9. Known Manufacturing Uses: Used in many applications where programs or data are entered into computers via rectangular-hole punched cards.

10. Known Sources of Information: Mr. John L. Little, NBS, (301) 921-3723; Mr. H. F. Ickes, IBM, (914) 463-9779.

11. Probable Sources of Information: Honeywell, UNIVAC

12. Bibliography: FIPS PUB 14/ANSI X3.26-1970, Hollerith Punched Card Code.

13. Comments: The Hollerith Punched Card Code has 256 hole patterns which map into 8-bit ASCII (see Table 1 of the ANSI Standard X3.26-1970) and also map into 8-bit EBCDIC, establishing the basis of code conversion between EBCDIC and ASCII, which is spoiled somewhat by IBM practice. See the writeup on "Code Conversion."

    The Hollerith Punched Card Code specified in ANSI Standard X3.26-1970 is based upon and earlier "Business" version having the symbols Ampersand, Commercial At, Number Sign, and Percent Sign included in a 48-character set. Several other versions, most notably a "Scientific" version which replaced some of the business symbols with FORTRAN algebra symbols Plus Sign, Apostrophe, Equals Sign, and Parentheses in a 48-character set are still in de facto use. When extended beyond 48 characters, these two versions employ the same set of Hollerith hole patterns in different ways, compatible with the earlier 48-character versions. The NBS UNIVAC 1108 "scientific" installation, for example, employs the standard hole patterns for some of the punctuation marks and special symbols (Period, Comma, Semicolon, Asterisk, Slant, Minus Sign, Dollar Sign) but deviates in the following hole pattern coding:

Hollerith Hole Pattern	ANSI X3.26-1970	NBS UNIVAC 1108 (Note 1)
12	Ampersand &	Plus Sign +
12-0 (Plus Zero)	Opening Brace {	Question Mark ?
11-0 (Minus Zero)	Closing Brace }	Exclamation Point !
8-2	Colon :	Ampersand &
8-3	Number Sign #	Equals Sign =
8-4	Commercial At @	Apostrophe '
8-5	Apostrophe '	Colon :
8-6	Equals Sign =	Greater Than >
8-7	Quotation Marks "	Commercial At @ (Master Space)
12-8-2	Opening Bracket {	(Not Used)
12-8-4	Less Than <	Closing Parenthesis)
12-8-5	Opening Parenthesis (	Opening Bracket {
12-8-6	Plus Sign +	Less Than <
12-8-7	Exclamation Point !	Number Sign #
11-8-2	Closing Bracket }	(Not Used)
11-8-5	Closing Parenthesis)	Closing Bracket }
11-8-7	Circumflex ^	Delta Δ (Note 2)
0-8-2	Reverse Slant \	Record Stop (Stop)
0-8-4	Percent Sign %	Opening Parenthesis (
0-8-5	Underline _	Percent Sign %
0-8-6	Greater Than >	Reverse Slant \
0-8-7	Question Mark ?	Losenge (Note 3)

Note 1 Input: UNIVAC 706 Card Reader
Output: UNIVAC 758 Printer

Note 2 Prints Circumflex (^) or Up Arrow (↑) on interactive ASCII terminals. Prints a triangle (Delta) (Δ) on batch terminals.

Note 3 Prints Quotation Marks (") on interactive ASCII terminals. Prints a Losenge or Rectangular Box on batch terminals.

Hollerith hole patterns for Space (no punches), 10 decimal digits (one punch), 26 Latin capital letters (two punches), as well as hole patterns for Period, Comma, and Asterisk (three punches) are universally standard, in accordance with ANSI X3.26-1970. Hole patterns for Minus Sign, Slant, and Dollar Sign are nearly universal, in accordance with ANSI X3.26-1970.

1. Designation: FIPS PUB 2/ANSI X3.6-1965

2. Title: Perforated Tape Code for Information Interchange

3. Maintenance Authority: ANSI X3B2

4. Scope: Hardware Standard. This standard specifies the representation of the Federal Standard Code for Information Interchange (FIPS PUB 1, ASCII) on perforated tape used in Federal information processing systems, communication systems, and associated equipment.

5. Relationship to Other Standards: See FIPS PUB 12-2, page 18 for 11 other standards related to this one, under "Media, Perforated Tape." EIA RS-358 is a subset of this code for numerical machine control perforated tape.

6. Competitive Standards: None recognized as standards. All perforated tape codes in use prior to 1965 are competitive. EIA RS-244A is an early competitive standard for numerical machine control perforated tape. Teletypesetter code is still used in newspaper communications and in typesetting perforated tape.

7. Standardization Status: FIPS PUB 2 was approved on November 1, 1968. ANSI X3.6-1965 was approved in 1965. Neither has been updated. EIA RS-244A has been rescinded in favor or EIA RS-358.

8. Implementation Status: Widely used in perforated tape equipment, including input/output to minicomputers and in communications.

9. Known Manufacturing Uses: The subset in EIA RS-358 is widely used in numerical control perforated tapes for drafting and machine control.

10. Known Sources of Information: Mr. John L. Little, NBS, (301) 921-3723; Mr. John B. Booth, Teletype Corporation, (312) 982-3630.

11. Probable Sources of Information: DEC, Honeywell

12. Bibliography: FIPS PUB 2/ANSI X3.6-1965, Perforated Tape Code for Information Interchange; FIPS PUB 12-2, page 18.

13. Comments: IBM has always emphasized punched cards and magnetic tape in preference to perforated tape. DEC uses perforated tape and magnetic tape in preference to punched cards.

1. Designation: ANSI X3.28-1976 Communication Protocol (Link Level) Standards - Character Oriented

2. Title: Procedures for the Use of the Communication Control Characters of ASCII in Specified Data Communication Links

3. Maintenance Authority: ANSI X3S3, Task Group 3

4. Scope: Protocols for Link Level Data Communication

5. Relationship to Other Standards:

   ANSI X3.4 (ASCII Character Set, Control Characters Used to Format Transmission)
   ISO R1745-1971 (Dialect)
   ECMA-16, 1973 (Dialect)[1]
   ISO R2111-1972 (Extension to Base Mode for Code-Independent Information Transfer)
   ISO R2629-1973 (Extension to Basic Mode for Conversational Information Transfer)
   ECMA-24, 1969 (Extension to Basic Mode for Code-Independent Information Transfer)
   ECMA-26, 1971 (Extension to Basic Mode for Recovery Procedures)
   ECMA-27, 1971 (Extension to Basic Mode for Abort and Interrupt Procedures)
   ECMA-28, 1971 (Extension to Basic Mode for Multiple Station Selection)
   ECMA-29, 1971 (Extension to Basic Mode for Conversational Information Transfer)
   ECMA-37, 1972 (Extension to Basic Mode for Supplementary Transmission Functions)

6. Competitive Standards: IBM's Binary Synchronous Communications, BISYNC/IBM Order No. GA27-3004- 2/10/70 (more extensive than X3.28, and utilizing EBCDIC Character Set).

7. Standardization Status: Revised Standard Issued in 1976.

8. Implementation Status: No known implementations adhering strictly to the standard classes of procedures. Each computer manufacturer has implemented a different part of X3.28. The standard specifies approximately 140 different system configurations that can be implemented conforming to the standard.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723.

11. Probable Sources of Information:

12. Bibliography: ANSI X3.28-1971, "Procedures for the Use of the Communication Control Characters of American National Standard Code for Information Interchange in Specified Data Communication Links", American National Standards Institute, Inc., New York, NY, 10018.

13. Comments: Not a FIPS standard because does not provide for compatibility and data interchange among different systems.

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[1]ECMA is European Computer Manufacturers Association

1. Designation: ANSI X3S34/589 (Draft 5) Communication Protocol (Link Level) Standards - Bit Oriented

2. Title: Proposed ANS for Advanced Data Communication Control Procedures (ADCCP) (Draft 5, 4/9/76)

3. Maintenance Authority: ANSI X3S3, Task Group 4

4. Scope: Hardware/Software. The (proposed) standard establishes procedures to be used on synchronous communications links.

5. Relationship to Other Standards: IBM Synchronous Data Link Control (SDLC) is a subset of ADCCP. IBM Document GA27-3093-1

6. Competitive Standards: ANSI X3.28 (character oriented), IBM BISYNC (Character oriented), DEC DDCMP

7. Standardization Status: Draft 5 being circulated for letter ballot.

8. Implementation Status: No known implementation operational. IBM's SDLC may be functional at this time. A number of microprocessor chips are being developed to be used as ADCCP link controllers; one known effort is Motorola.

9. Known Manufacturing Uses:

10. Known Sources of Information: ANSI Committee X3, Tech. Committee X3S3, Task Group 4; Mr. George E. Clark, NBS, (301) 921-3723.

11. Probable Sources of Information: IBM, Honeywell

12. Bibliography:

ANSI X3S34/589 (Fifth Draft) 4/9/76, Advanced Data Communication Control Procedures, American National Standards Institute.

Donnan, R. A., and J. Ray Kersey, "Synchronous Data Link Control: A Perspective", IBM Systems J., 13, 2, 197.

Sanders, R. W., and V. G. Cerf, "Compatibility or Chaos in Communications", Datamation, 3/76, pp. 50-55.

13. Comments: IBM is known to be basing most of its networking efforts on the use of SDLC as a link-level protocol.

1. Designation: DDCMP Communication Protocol (Link Level) - Bit Oriented

2. Title: DDCMP - Digital Data Communications Message Protocol, Ed. 3, 12/10/74

3. Maintenance Authority: Digital Equipment Corp., Maynard, Mass., 01754

4. Scope: Hardware/Software protocol to support message communication between (processes running on) computers.

5. Relationship to Other Standards:

6. Competitive Standards:

   Bit-oriented: ADCCP (ANSI X3S34/589, Draft 5); SDLC (IBM Document GA27-3093-1)
   Character-oriented: ANSI X3.28-1971; IBM Binary Synchronous Communications Protocol (IBM Document GA27-3004-2)

7. Standardization Status: Apparently an internal corporate standard for network implementations utilizing DEC computer equipment.

8. Implementation Status: In limited use in-house at DEC/Maynard.

9. Known Manufacturing Uses: None

10. Known Sources of Information: Mr. Stu Wecker, DEC, Maynard, Mass., 01754

11. Probable Sources of Information:

12. Bibliography: DDCMP: Digital Data Communications Message Protocol, Specification Document, Ed. 3, 12/10/74.

13. Comments: DDCMP is the (physical) link-level protocol supporting DNA, the Digital Network Architecture. The latter is the philosophical basis for the DECNET network systems yet to appear.

1. Designation: SNA - Systems Network Architecture

2. Title: Systems Network Architecture

3. Maintenance Authority: International Business Machines Corp., White Plains, N.Y. 10604

4. Scope: System (hardware and software) architecture for data communications and teleprocessing applications development and implementation. Includes the specification of link and higher levels of protocol.

5. Relationship to Other Standards: Similar in intent to CCITT X.25 and DEC's DNA. Specifics of various levels differ.

6. Competitive Standards: CCITT Recommendation X.25; Digital Equipment Corp. Digital Network Architecture (DNA) ARPANET Imp/Host protocol

7. Standardization Status: Not intended as a standard. SNA is being used in the development of several IBM product lines.

8. Implementation Status: Several IBM product lines, including point-of-sale terminal systems, are in various stages of implementation.

9. Known Manufacturing Uses: None

10. Known Sources of Information: IBM Systems Development Division, Advanced Systems Architecture, Dept. E97, P.O. Box 12195, Research Triangle Park, North Carolina, 27709

11. Probable Sources of Information:

12. Bibliography:

"Systems Network Architecture - General Information", IBM Doc. GA27-3102-0.

McFadyen, J. H. "Systems Network Architecture: An Overview", IBM Systems J., 15, 1, 1976, pp. 4-23.

Cullen, P. G. "The Transmission Subsystem in Systems Network Architecture", IBM Systems J., 15, 1, 1976, pp. 24-38.

Hobgood, W. S., "The Role of the Network Control Program in Systems Network Architecture", IBM Systems J., 15. 1, 1976, pp. 39-52.

13. Comments:

1. Designation: CCITT Recommendation X.25 Communication Protocol (Network Level) Standards - Packet Oriented

2. Title: CCITT Recommendation X.25 - Interface Between Data Terminal Equipment and Data Circuit-Termination Equipment for Terminals Operating in the Packet Mode on Public Data Networks

3. Maintenance Authority: CCITT

4. Scope: Hardware/Software standard covering protocols relating to packet-switched computer networks. Covers three levels: Physical (Level 1) - X21 (or RS-232); Link Access (Level 2) - HDLC Procedures; Packet format and control (Level 3) - Virtual Calls, Circuits.

5. Relationship to Other Standards:
CCITT Recommendation X.1 - Classes of service for DTE in packet mode.
CCITT Recommendation X.2 - User facilities in packet mode.
CCITT Recommendation X.21, X.21bis - DTE/DEC Interface Characteristics.
CCITT Recommendation X.92 - Logical control links.
CCITT Recommendation X.95 - Network parameters
CCITT Recommendation X.96 - Call progress signals.

6. Competitive Standards: IBM's System Network Architecture (SNA), IBM Document GA27-3102-0; DEC's Digital Network Architecture (DNA).

7. Standardization Status: Draft standard. Not yet official.

8. Implementation Status: Unknown

9. Known Manufacturing Uses: None

10. Known Sources of Information: Mr. George E. Clark, NBS, (301) 921-3723.

11. Probable Sources of Information:

12. Bibliography: Sanders, Ray W., Vincton G. Cerf, "Compatibility or Chaos in Communications", Datamation, 3/76, pp. 50-55; CCITT Recommendation X.25 (Doc. X3S37-76-14 and ANSI X3S33-76-6)

13. Comments: This recommendation provides the electrical, link, and packet level procedures to implement a data network. The first two are based on existing standards or draft standards, and the third level is defined in the X.25 document.

1. Designation: ARPANET Imp/Host Protocol

2. Title: ARPANET Imp/Host Protocol

3. Maintenance Authority: Bolt, Beranek and Newman, Inc., 50 Moulton St. Cambridge, Mass. 02138

4. Scope: Software/Hardware specification of protocol governing the interface between a DTE (Host) and the ARPANET (i.e., Imp).

5. Relationship to Other Standards: Similar to CCITT X.25, DEC's DNA and IBM's SNA.

6. Competitive Standards:

7. Standardization Status: None

8. Implementation Status: Operational

9. Known Manufacturing Uses: None

10. Known Sources of Information: Network Control Center, BBN, Cambridge, Mass.

11. Probable Sources of Information:

12. Bibliography:

Bolt Beranek and Newman, "Specifications for the Interconnection of a Host and an Imp", BBN Report 1822, Rev. 4/73.

Heart, F. E., et al., "The Interface Message Processor for the ARPA Computer Network", Proc. SJCC, 5/7/70, pp. 551-567.

13. Comments:

1. Designation: Digital Network Architecture

2. Title: Digital Network Architecture

3. Maintenance Authority: Digital Equipment Corp., Maynard, Mass. 01754

4. Scope: DNA is an architecture designed to permit the implementation of networks for data communication. It encompasses link (DDCMP), host/host (NSP), and process/process (DAP) level protocols for data and control communication.

5. Relationship to Other Standards: Similar in concept to IBM's SNA, CCITT Recommendation X.25, ARPANET Imp/Host Protocol

6. Competitive Standards: IBM's SNA, CCITT X.25, ARPANET Imp/Host Protocol

7. Standardization Status: Unknown

8. Implementation Status: Partial, primarily in-house.

9. Known Manufacturing Uses: Unknown

10. Known Sources of Information: Stu Wecker, Digital Equipment Corp., Maynard, Mass.

11. Probable Sources of Information:

12. Bibliography:

Wecker, S. "The Design of DECNET - A General Purpose Network Base" Presented at ELECTRO/76, Boston Mass., 5/76.

Digital Equipment Corp., "Digital Network Architecture - Design Specification for Network Services Protocol (NSP)", 7/10/75.

Digital Equipment Corp., "Digital Network Architecture - Design Specification for Digital Data Communications Message Protocol (DDCMP)", 12/10/75.

13. Comments:

1. Designation: ANSI X3J2/76-01

2. Title: Proposed American National Standard for Minimal BASIC, January, 1976.

3. Maintenance Authority: ANSI X3J2

4. Scope: BASIC (Beginners All-purpose Symbolic Instruction Code) was orginally developed at Dartmouth College for use by nonprogrammers. It was designed for interactive use in program construction and debugging. The range of usage of BASIC has grown beyond the scopes of the originally intended audience. Usage has expanded in universities as well as industrial organizations. BASIC is, in general, an easy-to-learn language and can be applied to nonnumerical as well as numerical problems.

5. Relationship to Other Standards: ANSI X3.4-1968 American National Standard Code for Information Interchange (base, 128-character set); ANSI X3.42-1975 The Representation of Numerical Values in Character Strings for Information Interchange (proposed Minimal BASIC accommodates forms stipulated in X3.42).

6. Competitive Standards: X3J3 dpANS FORTRAN[1]

7. Standardization Status: Approved by mail ballot of X3J2 and transmitted to X3 for action on 12/31/75. No official designation given as yet. The status of the standard at X3 is unclear at this time, as well as the plans for publication for comment.

8. Implementation Status: Honeywell 6635, 6080, 437; Hewlett-Packard 2000F, 3000; IBM 370/168, 145, 158; CDC 3300, 6500; PDP 1070; XDS 940; UNIVAC 1108.

9. Known Manufacturing Uses: Graphics, Interactive Language Requirements

10. Known Sources of Information: Dr. Thomas E. Kurtz, Director, Computation Center, Dartmouth College (Chairman X3J2); Mr. I. Trotter Hardy, NBS, (301) 921-3491, (NBS voting member on X3J2); Dr. David E. Gilsinn, NBS, (301) 921-3491.

11. Probable Sources of Information: IBM, Sperry Rand, Hewlett-Packard, General Electric, Dartmouth College, Digital Equipment Corporation, Control Data Corporation

12. Bibliography:

ANSI X3J2/76-01, Proposed American National Standard for Minimal Basic, Jan. 1976
BASIC/3000, HP
Real-Time BASIC, HP
IBM BASIC for the 370
BASIC (BNF) Burroughs
BASIC, CDC
BASIC, Multics
Xerox BASIC
JPL BASIC
GE Mark III BASIC
DEC, "BASIC-Plus Languages Manual"
Bennet P. Leintz, "A Comparative Evaluation of Versions of BASIC," Comm. of the ACM, April 1976, Vol. 19, No. 4, pp. 175-188.

13. Comments: The proposed standard specifies a minimum of 6 digits of numeric representation for precision. There is, however, a possible infinite loop case in the FOR-NEXT statement and there is a new language element OPTION BASE to specify array lower bounds that has not been implemented on any system.

[1] The FORTRAN standard was identified as a possible conflicting standard in the sense that BASIC is a FORTRAN-like language. However, BASIC is more interactively oriented and minimizes format considerations. Both can be used to solve similar problems.

1. Designation: FIPS PUB 21-1, ANSI X3.23-1974, ISO 1789

2. Title: American National Standard COBOL

3. Maintenance Authority: Commerce Department, National Bureau of Standards for FIPS PUB 21-1; ANSI X3J4 for ANSI X3.23-1974.

4. Scope: Programming language for use in computer applications that emphasize the manipulation of characters, records, files and input/output (as contrasted with those primarily concerned with computational problem solving).

5. Relationship to Other Standards: FIPS PUB 44 - Standard COBOL Coding Form

6. Competitive Standards: None

7. Standardization Status: The documents cited represent the current revisions of the COBOL standard.

8. Implementation Status: Wide range of general purpose computers.

9. Known Manufacturing Uses: No known use for applications directly contributing to the manufacturing process; however, as stated under "Scope" above, is appropriate for predominantly data manipulation applications, usually in support of business management functions.

10. Known Sources of Information: Ms. Mabel Vickers, NBS, COBOL Project Manager, (301) 921-3491; Jitze Couperus, Chairman, ANSI X3J4, (408) 734-7499.

11. Probable Sources of Information: William Rinehuls, USAF, DoD Standards Coordinator, (202) 695-6547

12. Bibliography:

FIPS PUB 21-1, COBOL, December 1, 1975
ANSI X3.23-1974, COBOL, May 10, 1974
CODASYL COBOL Journal of Development, 1976, (current developments of COBOL)
FIPS PUB 44, Standard COBOL Coding Form, September 1, 1976

13. Comments: The COBOL standard is supported by a mechanism for the continued development and standardization of the languge as dictated by user needs and state-of-the-art developments in language use and implementation. The Federal standard is supported by Federal Property Management Regulation 101-32.1305-1 which specifies the procurement and compiler testing policies applicable to Federal agencies.

1. Designation: ANSI X3.9-1966

2. Title: American National Standard FORTRAN

3. Maintenance Authority: ANSI X3J3

4. Scope: Programming language for scientific and engineering applications.

5. Relationship to Other Standards: ANSI X3.10-1966, Basic FORTRAN (subset); ANSI X3.42-1975, The Representation of Numeric Values in Character Strings for Information Interchange, (the FORTRAN standard accommodates forms stipulated in X3.42).

6. Competitive Standards: PL/I

7. Standardization Status: ANSI standardization completed March 1966; revision thereto is now out for public review, comment and X3 ballot; action date January 1977; new designation to be X3.9-1977.

8. Implementation Status: All general purpose computers; most manufacturers are now updating their compilers to meet the proposed revision.

9. Known Manufacturing Uses: Scientific applications, numerical control, preprocessors and postprocessors. Most scientific and engineering application programs are coded in FORTRAN.

10. Known Sources of Information: Mrs. Francis E. Holberton, NBS, (301) 921-3491; Mr. William F. Hanrahan, Secretary, ANSI X3, (202) 466-2288.

11. Probable Sources of Information:

12. Bibliography: ANSI X3.9-1966 (Current) ANS FORTRAN
ANSI X3 BSR 3.9, March 1976 (same as X3J3/76) draft proposed ANS FORTRAN

13. Comments:

1. Designation: MDC/28, MDC/33, and MDC/34

2. Title: MUMPS Language Standard

3. Maintenance Authority: MUMPS Development Committee

4. Scope: Programming language for interactive data handling.

5. Relationship to Other Standards: FIPS PUB 1/ANSI X3.4-1968, ASCII (base, 128-character set); FIPS PUB 15-1971 (base, 64-character graphic subset)

6. Competitive Standards: None

7. Standardization Status: ANSI letter ballot mailed May 24, 1976; action date November 24, 1976; designation to be ANSI X11.1

8. Implementation Status: Standard implementations: Artronix PC-16, Burroughs B-6700, DEC PDP-10, DEC PDP-11, IBM 360/370, Philips P856/857; being implemented on machines of six additional manufacturers.

9. Known Manufacturing Uses: String handling applications, such as in inventory control and parts cataloging.

10. Known Sources of Information: Mr. J. T. O'Neill, NBS, (301) 921-3485, Jack Bowie, Sc.D., Chairman, MUMPS Development Committee, (617) 726-3937.

11. Probable Sources of Information:

12. Bibliography:

NBS Handbook 118, issued January 1976, with errata dated March 9, 1976, MUMPS Language Standard[1]
MDC/29, 5/28/75, MUMPS Interpreter Validation Program User Guide
MDC/30, 6/25/75, MUMPS Translation Methodology
MDC/35, 10/14/75, MUMPS Documentation Manual
MDC 1/11, 6/13/75, MUMPS Primer
MDC 2/1, 5/15/75, MUMPS Globals and Their Implementation
MDC 2/2, 5/30/75, Design of a Multiprogramming System for the MUMPS Language
MDC 2/3, 6/15/75, Implementation of the MUMPS Language Standard
MDC 3/5, 8/31/76, MUMPS Programmers' Reference Manual

13. Comments:

[1] NBS Handbook 118 consists of three MUMPS Development Committee documents, namely, Part I, MDC/28, MUMPS Language Specification, dated March 12, 1975; Part II, MDC/33, MUMPS Transition Diagrams, dated September 17, 1975; and Part III, MDC/34, MUMPS Portability Requirements, dated September 17, 1975).

1. Designation: None

2. Title: PASCAL

3. Maintenance Authority: Prof. N. Wirth, Institut für Informatik, Clausiusstrasse 55, CH-8006 Zurich.

4. Scope: General purpose programming language.

5. Relationship to Other Standards: Designed to replace ALGOL 60. A commercially available process control language is a superset of PASCAL.

6. Competitive Standards: ALGOL-W

7. Standardization Status: The original PASCAL is the product of Prof. Wirth, so the standardization is fairly clear.

8. Implementation Status: Available on: DEC PDP-10, PDP-11; CDC 6000; CII IRIS 80, CII 10070; IBM 360/370; Univac 1108; XDS Sigma 7.

9. Known Manufacturing Uses: Scientific and engineering programming as well as some systems implementation programming.

10. Known Sources of Information: George H. Richmond, Editor, PASCAL Newletter, University of Colorado Computer Center, 3645 Marine Street Bolder, Colorado 80302

11. Probable Sources of Information:

12. Bibliography:

A. N. Habermann, "Critical comments on the programming language PASCAL," NTIS # PD-224 777, Oct. 1973, 22 pp.

C.A.R. and N. Wirth, "An axiomatic definition of the programming language PASCAL," 30 pp.

Kathleen Jensen and Niklaus Wirth, PASCAL: User Manual and Report, Lecture Notes in Computer Science 18, Springer-Verlag (New York, 1974), 169 pp. also Geo. H. Richmond, Ed., PASCAL Newsletter, from 1974 onward.

13. Comments: Primary community of users is found in academic institutions.

1. Designation: ANSI BSR X3.53 BASIS/1-12, Feb. 1975.

2. Title: PL/I

3. Maintenance Authority: ANSI

4. Scope: General purpose omnibus programming language.

5. Relationship to Other Standards: None, except that language is generally thought of as a replacement for both FORTRAN and COBOL, and probably ALGOL too.

6. Competitive Standards: dpANS FORTRAN, dpANS COBOL

7. Standardization Status: BASIS/1-12 + errata sent to ECMA General Assembly for vote in Jan. 1976. Also sent to ANSI X3 for general processing.

8. Implementation Status: All major IBM systems. Dialects on Honeywell, CDC, and university installations (PL/C, etc.), including Amdahl machines

9. Known Manufacturing Uses: Business, scientific, engineering.

10. Known Sources of Information: IBM Corporation; General Electric; Honeywell Multics documents, Cornell PL/C user guides, etc.

11. Probable Sources of Information:

12. Bibliography: ANSI BSR X3.53 BASIS/1-12, Feb. 1975
    BSR X3.53 Errata sheets, Jan. 1976
    BSR X3.53 CHAP. 1, revised Feb. 1976
    Many textbooks, e.g., W.W. Peterson

13. Comments: Standard is pending approval. PL/I is a very large and very powerful programming language. It was designed somewhat hurriedly and the design is therefore not the most elegant.

1. Designation: None

2. Title: Composite summary sheet on Simulation Languages[1]

3. Maintenance Authority: Various developers

4. Scope: Simulation languages can be divided into three clases, namely, continuous discrete, and hybrid. Continuous languages are for implementing models of systems having continuous dynamic change (i.e., sets of differential equations). Discrete, languages are for models showing discrete change (i.e., queuing and resource allocation). Hybrid languages combine both features into one package.

   The process of simulation involves:

   a. developing a system model expressed in mathematical, logical, or graphical notation,

   b. implementing the model in a computer using simulation language notation,

   c. validating the model to insure an acceptable degree of accuracy, and

   d. running the model to accrue experimental data.

   Simulation languages are usually of three programmatic types:

   1. routines for simulation embedded in a general source language such as FORTRAN,

   2. an entire higher order source language, or

   3. a data base-driven set of object code.

   In certain cases, simulation languages are employed in real-time to accept inputs sensed from some controlled system or process.

5. Relationship to Other Standards: N/A

6. Competitive Standards: N/A

7. Standardization Status: None

8. Implementation Status:

9. Known Manufacturing Uses: Control of processes; design of processes and facilities; resource allocation and planning.

10. Known Sources of Information: Mr. Paul F. Roth, NBS, (301) 921-3545.

11. Probable Sources of Information: Various developers

12. Bibliography: G. Gordon, System Simulation, Prentice Hall, 1969.

13. Comments: No standard summary sheets are included here because there are no standards in this area. Simulation languages are, in most instances, developed and/or supported by computer mainframe vendors or by software houses specializing in simulation. Simulation languages encompass such a wide variety of forms and uses that early voluntary standardization is unlikely; however, some de facto conventions might well be adopted for the Air Force ICAM effort.

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[1]Languages tentatively identified for detailed consideration are CSSL, CSMP, GASP IV, GPSS, and SIMSCRIPT.

1. Designation: None

2. Title: Basic Language for Implementation of System Software (BLISS)

3. Maintenance Authority: Digital Equipment Corporation (for official versions); Carnegie-Mellon University, Dept. of Computer Science (for unofficial versions).

4. Scope: De facto system implementation programming language standard for the Digital Equipment Corp. PDP-10 (BLISS 10) and PDP-11 (BLISS-11)

5. Relationship to Other Standards: It is assumed that the source is in ASCII.

6. Competitive Standards: BCPL (and variations, particularly C for the PDP-11); SAIL

7. Standardization Status: The de facto standard for the language BLISS is embodied in the implementations of BLISS-10 and BLISS-11 by Digital Equipment Corp. To date, there has been no effort to standardize this language.

8. Implementation Status: The language was designed and first implemented for the PDP-10 at Carnegie-Mellon University. It was later adopted by Digital Equipment Corp. and has become a supported language under their standard PDP-10 operating system. The PDP-11 version was likewise designed and first implemented at Carnegie-Mellon. It is now available from Digital Equipment Corp. via a cross compiler, i.e., it executes on a PDP-10, producing code for a PDP-11.

9. Known Manufacturing Uses: None

10. Known Sources of Information: Digital Equipment Corp., Maynard, MA; Carnegie-Mellon University, Dept. of Computer Science, Pittsburgh, PA.

11. Probable Sources of Information:

12. Bibliography:

BLISS-10 Programmer's Reference Manual (DEC-10-LBRMA-A-D), Digital Equipment Corp., Maynard, MA;

W.A. Wulf et al., BLISS Reference Manual: A Basic Language for Implementation of System Software for PDP-10, Dept. of Computer Science, Carnegie-Mellon University, Pittsburgh, PA.

13. Comments: Digital has implemented sophisticated FORTRAN compilers using both BLISS-10 and BLISS-11 as implementation languages.

1. Designation: None

2. Title: PL/S

3. Maintenance Authority: IBM Corp.

4. Scope: System implementation language used by IBM for the 360/370 series

5. Relationship to Other Standards:

6. Competitive Standards:

7. Standardization Status: The specification of PL/S has not been released by IBM.

8. Implementation Status: By implication, it can be assumed that IBM has implemented a compiler for PL/S, since much of the system software for the 370 series is written in PL/S. However, none of the source code is distributed, since IBM refuses to distribute the compiler.

9. Known Manufacturing Uses: None

10. Known Sources of Information: IBM Corp., Data Processing Division, 1133 Westchester Ave., White Plains, NY 10604.

11. Probable Sources of Information:

12. Bibliography:

Guide to PL/S II (Form GC28-6794-0), IBM Corp., Data Processing Division, White Plains, NY;
Guide to PL/S-Generated Listing (Form GC28-6786-0), IBM Corp., Data Processing Division, White Plains, NY;
G. Wiederhold and J. Ehrman, Inferred Syntax and Semantics of PL/S, in Proceedings of a SIGPLAN Symposium on Languages for Systems Implementation (published as SIGPLAN Notices, Volume 6, Number 9, Oct. 1971).

13. Comments: IBM appears to heavily use PL/S for its own internal system implementations. Unless IBM or someone else releases a PL/S compiler for general use, this language is of no utility to anyone but IBM.

1. Designation: None

2. Title: BCPL and C

3. Maintenance Authority: BCPL: installation-dependent; C: Bell Telephone Laboratories

4. Scope: BCPL (Basic Combined Programming Language) is a system implementation language. C is also a system implementation language developed as a significantly enhanced dialect of BCPL.

5. Relationship to Other Standards:

6. Competitive Standards:

7. Standardization Status: There has been no formal effort to standardize these languages.

8. Implementation Status: BCPL has been implemented on a wide variety of machines. The most important implementation of C has been for the DEC PDP-11. Other implementations exist for the IBM 360/370 and Honeywell 6000 series.

9. Known Manufacturing Uses:

10. Known Sources of Information: C: Dennis Ritchie, Bell Telephone Laboratories, Murray Hill, NJ 07974

11. Probable Sources of Information:

12. Bibliography:

M. Richards, The BCPL Reference Manual (Project MAC Memo M-352-1), M.I.T., Cambridge, MA (1968)

M. Richards, BCPL: A Tool for Compiler Writing and System Programming, Proceedings, Spring Joint Computer Conference (1969);

D. Ritchie, C Reference Manual, Bell Telephone Laboratories, Murray Hill, NJ.

13. Comments: Outside of a few user communities, BCPL has not been used heavily. The primary user community for C is that of PDP-11 UNIX users. The UNIX operating system is almost completely written in C, and C is the best supported and most heavily used language available on UNIX.

1. Designation: None

2. Title: PL/M, PL/M6800, and MPL

3. Maintenance Authority: Intel Corp. (PL/M for the Intel 8008 and 8080); Intermetrics (PL/M6800 for the Motorola 6800); Motorola Corp. (MPL for the Motorola 6800)

4. Scope: All three of these languages are high level system implementation languages for 8-bit microprocessors.

5. Relationship to Other Standards:

6. Competitive Standards:

7. Standardization Status: To date, none of these languages has been the subject of standardization. However, there has been some effort to make PL/M and PL/M6800 compatible at the source code level.

8. Implementation Status: Cross compilers exist for all three of these languages and are available through nationwide timesharing services or as FORTRAN programs designed to run on a user's IBM 360/370 system.

9. Known Manufacturing Uses:

10. Known Sources of Information:

11. Probable Sources of Information:

12. Bibliography:

8008 and 8080 PL/M Programming Manual - Revision A (MCS-451-0275-10K), Intel Corp., Santa Clara, CA (1975);

D. Fylstra and R. Gardner, PL/M6800 Language Specification (Report No. IR-161), Intermetrics Inc., Cambridge, MA (1975).

13. Comments: PL/M and PL/M6800 offer an almost completely compatible language for programming Intel 8080 and Motorola 6800 microprocessors. MPL for the Motorola 6800 was not designed to be compatible. However, all three of these languages are subset dialects of PL/I and therefore will have a high degree of similarity.

1. Designation: None

2. Title: Composite summary sheet on Artificial Intelligence (AI) Languages[1]

3. Maintenance Authority: Various developers

4. Scope: Novel features (new data types and control structures, pattern matching, deductive mechanisms, etc.) embedded in programming languages for robotics, automatic programming, and the representation of knowledge (see bibliographic citation 12. a. below).

5. Relationship to Other Standards: N/A

6. Competitive Standards: N/A

7. Standardization Status: None

8. Implementation Status:

9. Known Manufacturing Uses: ". . . heuristic programming, algebraic manipulation, . . . pattern recognition, . . . information retrieval, numerical computation" (see bibliographic citation 12. b. below).

10. Known Sources of Information: See bibliography.

11. Probable Sources of Information:

12. Bibliography:

a. Bobrow, Daniel G. and Bertram Raphael, New Programming Languages for Artificial Intelligence, Computing Surveys, Vol. 6, No. 3, September 1974 (with 31 bibliographic entries).

b. Abrahams, Paul W. et. al., The LISP 2 Programming Language and System, Proc. FJCC, Vol. 29, (1966).

c. SAIL User Manual, Stanford Artificial Intelligence Laboratory, Memo AIM-204, Computer Science Department Report STAN-CS-73-373, July 1973.

d. Sammet, Jean E., Programming Languages: History and Fundamentals, 1969.

13. Comments: "For more than a decade, the list processing and symbol-manipulation languages -- such as COMIT, IPL, LISP, SLIP (Bobrow Raphael 1964) -- have been the media for almost all AI achievements. Although the effectiveness of research with these languages has improved dramatically due primarily to greatly expanded memory sizes and new interactive debugging facilities, the languages have remained remarkably stable. In recent years, however, new directions for emphasis in AI research -- such as studies of representation of knowledge, robotics, and automatic programming -- have led to a widely felt need for certain rather novel features to be embedded into programming languages; and some languages containing several of these features have recently been implemented" (see bibliography citation 12. a. above).

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[1] Languages tentatively identified for detailed consideration are SAIL, PLANNER/CONNIVER, QLISP/INTERLISP, POPLER/POP-2, and LISP 2.

1. Designation: None

2. Title: CODASYL Data Base Task Group (DBTG) Specification

3. Maintenance Authority: CODASYL Data Description Language Committee for the Data Definition Language (DDL) portion; CODASYL Programming Language Committee for the Data Manipulation Language (DML) portion.

4. Scope: Proposed standard for data base management systems. The DBTG specification includes the DDL and the DML.

5. Relationship to Other Standards: ANSI COBOL (base for DML specification).

6. Competitive Standards: ANSI X3/SPARC/DBMS Interim Report; Non-CODASYL Self-Contained approaches; Non-CODASYL Host Language approaches; Relational approaches.

7. Standardization Status: None

8. Implementation Status: There are commercial data base systems implemented, based on the CODASYL specification. While these systems may employ syntax that is slightly different from the CODASYL specification, they follow the same basic data model. Some of the commercially available systems which are generally deemed to be "CODASYL DBTG type" systems are:

   - DBMS-10 (Data Base Management System-10) developed by Rapidata, Inc.; as a Digital Equipment Corporation product runs on the DEC PDP-10.

   - IDMS (Integrated Data Management System) developed by Cullinane Corporation runs on IBM 360/370 and on UNIVAC 70.

   - DMS 1100 (Data Management System 1100) developed by Xerox runs on the Xerox SIGMA 6, 7, 9 and 560 machines.

9. Known Manufacturing Uses: Used primarily for business applications such as payroll and inventory control.

10. Known Sources of Information: Chairman, DDLC, CODASYL, Box 124, Monroeville, PA 15146

11. Probable Sources of Information: Cullinane, Rapidata, DEC, UNIVAC, NBS.

12. Bibliography:

1.a. CODASYL Programming Language Committee, Data Base Task Group Report. Available from ACM, April 1971.

1.b. CODASYL Data Description Language Committee, CODASYL Data Description Language, Journal of Development, U.S. Department of Commerce, NBS, NBS Handbook 113.

1.c. CODASYL Programming Language Committee, COBOL Journal of Development 1976, Chapter 12 - Data Manipulation Language, Section 4 - Subschema Specifications.

13. Comments: In May 1967, the Conference on Data Systems Languages (CODASYL) formed a group called the Data Base Task Group (DBTG). In October 1969, the DBTG produced a specification of a data base known as the DBTG Report (1.a.). The report detailed the semantics and syntax of a Data Description Language (DDL) and a Data Manipulation Language (DML). The DDL is a language for describing a data base. The DML is a language which is associated with a host language such as COBOL, FORTRAN, PL/I, etc., and which allows the manipulation of the data bases described by the DDL.

The Data Definition Language was developed with the intent that it would eventually become the basis for an industry standard and that many individual host languages could interface with implementations of it. A Data Description Language Committee was established. This Committee produced a CODASYL Data Description Language Journal of Development dated June 1973 (1.b.).

The data manipulation work was continued under the Programming Language Committee with the goal of developing subschemas and a DML specification. A CODASYL COBOL Journal of Development which specifies the Data Manipulation Language and subschema for COBOL was published in May 1975 (1.c.). Similar specifications for FORTRAN and perhaps for PL/I are still in the working stage.

1. Designation: None (composite summary sheet)

2. Title: Composite summary sheet on Self-Contained Data Management Approach

3. Maintenance Authority:

4. Scope: The majority of the commercially available data base management systems are of this type. They are widely used by government and industry as a nucleus in building special applications for customized data processing work.

5. Relationship to Other Standards: COBOL, FORTRAN, PL/I (for procedural language interface).

6. Competitive Standards: CODASYL DBTG Specification

7. Standardization Status: None

8. Implementation Status: There are many operational packages that are commercially available. These packages differ in the functions provided. Among the many, the following packages are believed to be representative of widely recognized and proven products available in the market today.

Package Name	Supplier	Computers	Initial Installation	No. of Users [1]
ADABAS	Software Ag.	IBM 360/370	March 1971 (in Germany) Marketed in U.S. since early 1972.	Over 150 as of May 1976
INQUIRE	Infodata Systems Inc.	IBM 360/370	1969	Approximately 70 as of May 1976
MODEL 204	Computer Corp. of America	IBM 360/370	1971	22 as of May 1976
System 2000	MRI Systems Inc.	IBM 360/370 UNIVAC 1100 Series CDC 6000 Series	July 1970	Over 100 as of May 1976

9. Known Manufacturing Uses: Current applications are: management information systems, inventory control, ecological data bases, personnel information systems, project control systems, pharmaceutical use history, health records, petrochemical data base, etc.

10. Known Sources of Information: Datapro Research Corporation, Delran, NJ

11. Probable Sources of Information: Specific Vendors of Systems: Software Ag.; Infodata Systems, Inc.; Computer Corp. of America; MRI Systems, Inc.

12. Bibliography:

2.a. CODASYL Systems Committee, "Feature Analysis of Generalized Data Base Management Systems," May 1971.
2.b. Datapro Research Corp, "A Buyer's Guide to Data Base Management Systems, "May 1976.
2.c. Koehr, G. J., et. al., "Data Management Systems Catalog." MITRE Corp. Report MTP-139, Jan. 1973.

13. Comments: "Self-contained" type of data base management systems is a classification distinguished by the CODASYL Systems Committee (2.a.). The key characteristic of the self-contained type is that the data definition, data retrieval and data input are all provided in such a way that conventional procedural programming is not required.

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[1] Data gathered from bibliographic citation 2.b.

1. Designation: None (composite summary sheet)

2. Title: Composite summary sheet on Host Language Data Management Approach

3. Maintenance Authority:

4. Scope: The majority of host language type data base management systems are based on the CODASYL DBTG Specification. However, IMS (Information Management System), an IBM product, is of the non-CODASYL host language type. TOTAL, developed by Cincom Systems, came out in early 1968 before the CODASYL DBTG Specification; it too is a non-CODASYL host language type. The two packages alone account for approximately 50% of the current market.

5. Relationship to Other Standards: COBOL, FORTRAN, PL/I (base for host language)

6. Competitive Standards: CODASYL DBTG Specification

7. Standardization Status:

8. Implementation Status: IMS (Information Management System), developed and marketed by IBM, has gone through many evolutions and improvements. The earliest, IMS-I, operating on the IBM 360, appeared around 1969 and is based on another product developed jointly with North American Rockwell Company called DL/I (Data Language/I), which is a data description facility to describe and organize a hierarchically structured data base. IMS-I also provides an interface through which programmers can store data from the host language (COBOL). In 1971, IMS-VS was released to run on IBM 360/370s, under the VS (Virtual System) operating system. The IMS data base management package is the leading package among IBM 360/370 computer users. It is estimated that there were 1,000 installations at year-end 1975 (3.a.).

   TOTAL, developed by Cincom, is widely used and is second to IMS. TOTAL, in its initial release in 1968 was primarily a direct access data base management system. Facilities were soon added to process DBTG-like sets implemented with chain pointers. TOTAL is a host language system which can model the major data stuctures of the DBTG specification. It is considered non-CODASYL because Cincom claims TOTAL was implemented before CODASYL DBTG was published. TOTAL runs on the following machines: IBM 360/370, Honeywell 200/2000, UNIVAC Series 70 and 9400/9700, NCR Century Series, CDC 6000 Series, and IBM System/3 Model 10 and Model 15. TOTAL had 900 installations at year-end 1975 (3.a.).

9. Known Manufacturing Uses: Used in support of a large number of diverse applications, including applications in manufacturing, finance, and process control.

10. Known Sources of Information: 3.a. International Data Corp., "The Data Base Management Software Market on IBM 360/370 Systems," IDC # 1685, (May 1976) International Data Corp., 214 Third Ave., Waltham, MA 02154. For IBM information, see local representative. For information on TOTAL: Cincom Systems, Inc., 2300 Montana Ave., Cincinnati, OH 43211

11. Probable Sources of Information: Government users of IMS package are: Federal Reserve Board and Naval Materiel Command Support Activity. Users of TOTAL package are: Social Security Administration and Bureau of Labor Statistics.

12. Bibliography: None

13. Comments:

1. Designation: None

2. Title: Composite summary sheet on Relational Data Management Approach

3. Maintenance Authority:

4. Scope: It is still being researched within academia.

5. Relationship to Other Standards: None

6. Competitive Standards: CODASYL DBTG Specification

7. Standardization Status: None

8. Implementation Status: The concepts of n-ary relations as a tool for data base management systems dates from a 1970 paper by E.F. Cudd of IBM (4.a.). As yet, no large scale implementation exists. There were a number of early projects: MACAIMS developed at MIT and RDMS developed at General Motors. A large scale prototype data base management system, called System R, is presently under construction at IBM Research in San Jose. Another large scale attempt at constructing a relational prototype is the INGRES (Interactive Graphics and Retrieval System) of the University of California at Berkeley. INGRES is operational on a PDP-11/40 under the UNIX operating system.

   There are two commercially-developed data base software packages which claim to possess relational characteristics, but these are not considered true relational systems:

   ° MAGNUM, developed by Tymshare, Inc., runs on IBM 360/370.

   ° NOMAN, developed by National CSS, Inc., also runs on IBM 360/370.

9. Known Manufacturing Uses: There are no known manufacturing uses of the prototype university-based relational systems. Limited uses of the two commercial relational systems are: maintenance and inventory data, and invoice processing by a utility company.

10. Known Sources of Information: E.F. Codd, IBM Research Laboratory, San Jose, CA; For INGRES System contact: M. Stonebraker, University of California, Berkeley, CA; for MAGNUM System contact: Tymshare, 10340 Bubb Road, Cupertino, CA 95014; for NOMAN System contact: National CSS, Inc., 300 Westport Ave., Norwalk, CT 06851

11. Probable Sources of Information:

12. Bibliography:

4.a. Codd, E.F., "A Relational Model of Data For Large Shared Data Banks," Communications of the ACM 13.6 (June 1970), pp. 377-397.

13. Comments:

1. Designation: None

2. Title: Composite summary sheet on Operating Systems

3. Maintenance Authority: Various vendors

4. Scope: The functions of a modern operating system can be divided roughly into: 1) job control (job and process scheduling and control), 2) storage management (allocation of main and secondary memory resources), and 3) file system implementation.

   Communication with an operating system is across two interfaces: system calls and an operating system command language (OSCL). System calls can be thought of as procedure calls to special operating system procedures. They are used in programs to request services of the operating system. An operating system command language is a self-contained but often rudimentary language for direct communication between a user and the operating system. The command language is used to schedule jobs, assign files, etc., and to otherwise direct the execution of programs on behalf of the user. On some of the more well-designed operating systems, the command language exists as a separable part of the system, and thus can be easily changed. In fact, some of these systems can support more than one command language.

5. Relationship to Other Standards: Operating systems require a great deal of interaction with hardware interface standards, code standards and language standards.

6. Competitive Standards:

7. Standardization Status: There have been some attempts to develop a standard operating system command language. These attempts have not succeeded. There appears to be little vendor support for these efforts.

8. Implementation Status:

9. Known Manufacturing Uses:

10. Known Sources of Information: Various vendors.

11. Probable Sources of Information:

12. Bibliography:

Code, Inc., Standardized Job Control Language: Introduction to SJCL Concepts, 1971 October 22, (NTIS AD 742 542).

13. Comments: No standard summary sheets are included in this section because there are no standards in this area. Each vendor of operating systems has a unique approach to the implementation of the user-system interface. No operating system in widespread use can be said to possess sufficient redeeming qualities in its user-system interface that acceptance of it as even an ad hoc standard can be advocated. In fact, very few vendors use the same user-system interface from one generation to another.

1. Designation: None

2. Title: Composite summary sheet on Computer Software (Testing and Validation)

3. Maintenance Authority: COBOL: (U.S. Navy); FORTRAN: (NBS); BASIC (NBS), MUMPS (MUMPS Development Committee)

4. Scope: Test for compiler compliance with 1968 COBOL and 1966 FORTRAN standards, and for ANSI proposed Minimal BASIC and MUMPS standards.

5. Relationship to Other Standards: Complement present or pending standards for COBOL, FORTRAN, BASIC and MUMPS.

6. Competitive Standards:

7. Standardization Status: COBOL 1968 and FORTRAN 1966 are available; Minimal BASIC and MUMPS are pending standards.

8. Implementation Status: Test data available from Federal Testing Service or NTIS. (BASIC) - NTIS & NBS

9. Known Manufacturing Uses: System procurement and quality control aids.

10. Known Sources of Information: Mrs. Frances E. Holberton (FORTRAN), Ms. Mabel V. Vickers (COBOL). Dr. David E. Gilsinn (BASIC), NBS, (301) 921-3491, Dr. Jack Bowie (MUMPS), Massachusetts General Hospital, (617) 726-3937.

11. Probable Sources of Information:

12. Bibliography: Federal Property Management Regulations 101-32.1305a, Validation of COBOL Compilers; NBS Special Publication 399, Vol. 1-3 "NBS FORTRAN Test Programs." NBS-IR (in draft) "Proposed NBS Minimal BASIC Test Programs." MDC/29, MUMPS Validation Program User Guide.

13. Comments: COBOL testing is used in acquisition of compilers for the Federal Govenment.

1. Designation: None

2. Title: Numerical Testing and Validation of Mathematical Software

3. Maintenance Authority: None, although some certification of algorithms and programs is given in the ACM algorithms collection and both IMSL (International Mathematical and Statistical Libraries, Inc.) and Argonne National Laboratory have produced and continue to test specialized mathematical libraries.

4. Scope: To define methods and guidelines to evaluate the numeric properties (such as accuracy) and ascertain this domain of mathematical software (that is, identify clearly the class of problems that a program solves). Another measure addressed is the speed of the programs. These qualities are referred to as the performance evaluation of mathematical software.

5. Relationship to Other Standards: Error analysis of mathematical software depends strongly on numeric representations. This subject is addressed from the point of view of character strings by ANSI X3.42-1975, American National Standard for the representation of numeric values in character strings for information interchange. Extrinsic mathematical functions routine capability is specified by the proposed ANS FORTRAN, BSR X3.9 and proposed ANS Minimal BASIC, BSR X3.60.

6. Competitive Standards: There are no standards for evaluations of mathematical software although there are a number of competitive approaches to evaluating the effect of error propagations in mathematical software (see comments below).

7. Standardization Status: None, although there is a recently organized IFIPS Working Group on Numerical Software (WG 2.5). The ACM SIGNUM, SIGMAP and SIGSAM are concerned with mathematical software.

8. Implementation Status: Ad hoc evaluation tools have been used by IMSL and Argonne. IBM has implemented in S/360 a quality mathematical function library developed at the University of Chicago. UNIVAC has also used a quality evaluation methodology to enhance the accuracy of its mathematics libraries.

9. Known Manufacturing Uses: To develop and evaluate the mathematical function software libraries peripheral to the programming languages FORTRAN, ALGOL, PL/I, BASIC, etc. IMSL uses evaluation techniques to generate quality mathematical software for engineering and scientific use.

10. Known Sources of Information: David E. Gilsinn, NBS, (301) 921-3491; Dan Lozier, NBS, (301) 921-2631.

11. Probable Sources of Information: IMSL, Argonne National Lab., Jet Propulsion Lab.

12. Bibliography: This bibliography is by no means exhaustive, but it covers a fair sampling of the literature dealing with tools and approaches to quality testing.

(1) W. J. Cody, "The Evaluation of Mathematical Software," Program Test Methods, Ed., William C. Hetzel, Prentice-Hall, Inc., Englewood Cliffs, NJ (1973), p. 121.

(2) C. T. Fike, Computer Evaluation of Mathematical Functions, Prentice-Hall, Inc., Englewood Cliffs, NJ, (1968).

(3) H. Kuki, "Mathematical Function Subprograms for Basic System Libraries -- Objectives, Constraints and Trade-Offs," Mathematical Software, Academic Press, NY, pp. 187-199.

(4) D. W. Lozier, L. C. Maximon, and W. L. Sadowski, "Performance Testing of a FORTRAN Library of Mathematical Functions Routines -- A Case Study in the Application of Testing Techniques," Journ. of Res., NBS, B. Math. Sci., Vol. 77B, Nos. 3 & 4, July - December 1973.

13. Comments: There are a number of proposed approaches to quality evaluation of mathematical software. There has been no concerted effort to determine which methods are appropriate to which programs. First, a straightforward approach to determining accuracy is to run a program on a standard set of problems and to compare the computed results against the known results. For certain problems this method can give meaningful and useful measures of the error generated within the routine. In particular, the accuracy of mathematical function routines is frequently determined by using the comparison approach. This method of analysis is sometimes called forward error analysis. Second, when a solution of a problem involves arrays of numbers, then another approach to quality evaluation is to show that the computed results are the exact solutions to a perturbation of the original problems and to measure that perturbation. This method is sometimes called backward error analysis. Third, the domain of the problem is evaluated. That is, the problems that a particular piece of mathematical software solves are determined. This method is related to method one, but requires a classification and codification of problem sets. Fourth, another approach to studying error propagations is statistical in the sense that the errors incurred for each operation are assumed to be random variables with some specified distribution. The error analysis can then proceed, using the tools of probability theory in order to determine the resulting error distributions, by computing the individual error random variables. Finally for some problems a-priori error bounds can be estimated by the use of inequalities and bounds for the accumulated error at each step of a program.

1. Designation: FIPS PUB 38

2. Title: Guidelines for Documentation of Computer Programs and Automated Data Systems

3. Maintenance Authority: NBS (FIPS TG 14)

4. Scope: These software guidelines provide a basis for determining the content and extent of documentation for computer programs and automated data systems.

5. Relationship to Other Standards: FIPS PUB 30 (subset)

6. Competitive Standards: None

7. Standardization Status:

8. Implementation Status: Published on Feb. 15, 1976.

9. Known Manufacturing Uses: These documentation guidelines are applicable to all computer software development and use applications.

10. Known Sources of Information: James Gillespie, USN, FIPS TG 14 Chairman, (202) 695-0680; Thomas Kurihara, Department of Agriculture, FIPS TG 14 Vice-Chairman, (202) 447-6261; Bea Marron, NBS, FIPS TG 14 Executive Secretary, (301) 921-3491

11. Probable Sources of Information:

12. Bibliography:

FIPS PUB 38, February 1975, Guidelines for Documentation of Computer Programs and Automated Data Systems

Automated Data System Documentation Standards Manual, Department of Defense Manual 4120.17-M, December 1972

Computer Program Documentation Guideline, National Aeronautics and Space Administration, NHB-2411.1, July 1971.

13. Comments: Documentation of computer software provides information to support the effective management of ADP resources and to facilitate the interchange of information. It serves to:

- Provide managers with technical documents to review at the significant development milestones, to determine that requirements have been met and that resources should continue to be expended.

- Record technical information to allow coordination of later development and use/ modification of the software.

- Facilitate understanding among managers, developers, programmers, operators, and users by providing information about maintenance, training, changes, and operation of the software.

- Inform potential users of the functions and capabilities of the software, so that they can determine whether it will serve their needs.

These guilelines were prepared to improve the quality and consistency of software documentation.

1. Designation: FIPS PUB 30, Standard Form 185

2. Title: Software Summary for Describing Computer Programs and Automated Data Systems

3. Maintenance Authority: NBS

4. Scope: This standard software summary form is used in documenting summaries or abstracts of programs and/or automated data systems that are developed or acquired by Federal departments and agencies.

5. Relationship to Other Standards: FIPS PUB 38 (superset)

6. Competitive Standards: None, but ANSI X3K7 was organized in October 1975 to develop a computer program abstract.

7. Standardization Status: Published June 30, 1974

8. Implementation Status: On Feb. 25, 1976, a Federal Property Management Regulation was announced which requires the use of this standard form for reporting "common use software" to a new Federal Software Exchange Center.

9. Known Manufacturing Uses: This documentation standard is applicable to all computer software development and use applications.

10. Known Sources of Information: James Gillespie, FIPS TG 14 Chairman; Thomas Kurihara, FIPS TG 14 Vice-Chariman; Bea Marron, FIPS TG 14 Executive Secretary.

11. Probable Sources of Information:

12. Bibliography: FIPS PUB 30, June 1974, Software Summary for Describing Computer Programs and Automated Data Systems

13. Comments: This standard, a one-page form with instructions on the back, is intended for succinctly describing computer programs and automated data systems for identification, reference, and dissemination purposes.

1. Designation: FIPS PUB 24

2. Title: Flowchart Symbols and their Usage in Information Processing

3. Maintenance Authority: NBS (ICST)

4. Scope: This publication establishes standard flowchart symbols and specifies their use in the preparation of flowcharts in documenting information processing systems.

5. Relationship to Other Standards: Same as ANSI X3.5 - 1970, American National Standard Flowchart Symbols and their Usage in Information Processing.

6. Competitive Standards: None

7. Standardization Status: Published June 30, 1973. The ANSI standard was approved Sept. 1, 1970 as a revision of USA Standard X3.5 - 1968.

8. Implementation Status: This standard applies to any Federal information processing operation where symbolic representation is desirable to document the sequence of operations and the flow of data and paperwork.

9. Known Manufacturing Uses: Applicable for all systems and software documentation.

10. Known Sources of Information: Mr. Harry S. White, Jr, NBS, (301) 921-3157.

11. Probable Sources of Information:

12. Bibliography: FIPS PUB 24, June 1973, Flowchart Symbols and their Usage in Information

13. Comments: A FIPS Jiffy Template (#673) of Flowchart Symbols, which conforms to FIPS PUB 24, is now available.

ANNOTATION FOR THE AOOITION OF OESCRIPTIVE COMMENTS OR EXPLANATORY NOTES AS CLARIFICATION	AUXILIARY OPERATION OFFLINE OPERATIONS PERFORMEO ON EOUIPMENT NOT UNDER OIRECT CONTROL OF THE CENTRAL PROCESSOR.	CONNECTOR A JUNCTION IN THE LINE OF FLOW	CORE I/O FUNCTION IN WHICH THE MEDIUM IS MAGNETIC CORE (USE AUXILIARY OPERATION SYMBOL)
OECISION POINTS IN A PROGRAM WHERE SEVERAL PATHS MAY BE POSSIBLE, BASED ON VARIABLE CONOITIONS	OISPLAY I/O FUNCTION IN WHICH THE INFORMATION IS OISPLAYED FOR HUMAN USE AT TIME OF PROCESSING.	DOCUMENT I/O FUNCTION IN WHICH THE MEDIUM IS A OOCUMENT	EXTRACT REMOVAL OF ONE OR MORE SPECIFIC SETS OF ITEMS FROM A SINGLE SET OF ITEMS.
INPUT/OUTPUT MAKING AVAILABLE INFORMATION FOR PROCESSING OR RECOROING PROCESSEO INFORMATION	MAGNETIC DISK I/O FUNCTION IN WHICH MEDIUM IS MAGNETIC OISK	MAGNETIC ORUM I/O FUNCTION IN WHICH MEOIUM IS MAGNETIC ORUM	MAGNETIC TAPE I/O FUNCTION IN WHICH THE MEOIUM IS MAGNETIC TAPE
MANUAL INPUT I/O FUNCTION IN WHICH THE INFORMATION IS ENTEREO MANUALLY AT THE TIME OF PROCESSING.	MANUAL OPERATION ANY OFFLINE PROCESS GEARED TO THE SPEEO OF A HUMAN BEING	MERGE COMBINING TWO OR MORE SETS INTO ONE SET	OFFLINE STORAGE REPRESENTS ANY OFFLINE STORAGE OF INFORMATION REGARDLESS OF THE MEOIUM
ONLINE STORAGE REPRESENTS AN I/O FUNCTION UTILIZING MASS STORAGE THAT CAN BE ACCESSED ON LINE	PRE-DEFINEO PROCESS A NAMEO PROCESS CONSISTING OF ONE OR MORE OPERATIONS OR PROGRAM STEPS, SPECIFIED ELSEWHERE. (SUBROUTINE)	PREPARATION A GROUP OF INSTRUCTIONS WHICH MOOIFY, UPOATE, CORRECT OR OTHERWISE CHANGE THE PROGRAM	PROCESS REPRESENTS THE PROCESS OF EXECUTING A DEFINEO OPERATION OR GROUP OF OPERATIONS
PUNCHED CARO I/O FUNCTION IN WHICH THE MEDIUM IS PUNCHED CAROS INCLUOING MARK SENSE CARDS, STUB CARDS	PUNCHEO TAPE I/O FUNCTION IN WHICH THE MEOIUM IS PUNCHED TAPE	SORT ARRANGING A SET INTO A PARTICULAR SEOUENCE (USE EXTRACT ANO MERGE)	TERMINAL A POINT AT WHICH INFORMATION CAN ENTER OR LEAVE

1. Designation: Data Element Standards (composite summary sheet)

   FIPS PUB 4 - Calendar Date
   FIPS PUB 5-1 - States and Outlying Areas of the United States
   FIPS PUB 62 - Counties and County Equivalents of the States of the United States
   FIPS PUB 8-4 - Standard Metropolitan Statistical Areas
   FIPS PUB 10-1 - Countries, Dependencies, and Areas of Special Sovereignty
   FIPS PUB 19 - Guidelines for Registering Data Codes

2. Title:

3. Maintenance Authority: NBS

4. Scope: Data Element Representations and Codes

5. Relationship to Other Standards: (See individual publications)

6. Competitive Standards:

7. Standardization Status: (See individual publications)

8. Implementation Status: (See individual publications)

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. Harry S. White, Jr., NBS, (301) 921-3157

11. Probable Sources of Information:

12. Bibliography: (See individual publications)

13. Comments: These data elements are not directly relevant to CAM; on the other hand, if any of these data elements are utilized in a CAM system, the standard formats should be followed to allow transferability. In addition, these standards offer models for standardizing the data elements that are directly relevant to CAM.

1. Designation: FIPS PUB 11/ANSI X3.12-1970

2. Title: Vocabulary for Information Processing

3. Maintenance Authority: NBS

4. Scope: This Vocabulary is a reference document for general use throughout the Federal Government to help promote a common understanding of information processing activities.

5. Relationship to Other Standards: Same as ANSI X3.12-1970

6. Competitive Standards: None known.

7. Standardization Status: Published Dec. 1, 1970. The ANSI Standard was approved Feb. 18, 1970 as a revision of U.S.A. Standard X3.12-1966.

8. Implementation Status:

9. Known Manufacturing Uses: Applicable to all information processing activities.

10. Known Sources of Information: Mr. Harry S. White, Jr., NBS, (301) 921-3157; Ms. Josephine Walkowicz, NBS, (301) 921-3485.

11. Probable Sources of Information:

12. Bibliography:

13. Comments: An "American National Dictionary of Information Processing" will be issued as an ANSI Technical Report on or about October 1, 1976.

1. Designation: ANSI X8.1-1968/ISO 841-1974/EIA RS-267-A-1967/NAS 938-1962

2. Title: Axis and Motion Nomenclature for Numerically Controlled Machines

3. Maintenance Authority: EIA EI-31; ISO/TC97/SC8

4. Scope: Hardware Standard. This standard defines axis and motion nomenclature for numerically controlled machines.

5. Relationship to Other Standards: Definitions of terms (in the ANSI/EIA standard) are in accordance with EIA Automation Bulletin 3B.

6. Competitive Standards:

7. Standardization Status: This standard was approved as NAS 938 in June 1959 and revised by NAS in February 1963. EIA RS-267 was approved in July 1962 and was revised in June 1967 as RS-267-A which was approved as ANSI X8.1 in March 1968. ISO R841 was approved in 1968 and reissued as ISO 841 in July 1974.

8. Implementation Status: Widely used in numerical control equipment.

9. Known Manufacturing Uses: Widely used in numerical control applications to drafting machines, plotters, and machine tools.

10. Known Sources of Information: Mr. A. M. Wilson, EIA, (202) 659-2200

11. Probable Sources of Information: NMTBA, AIA

12. Bibliography: ANSI X8.1-1968/ISO 841/1974/EIA RS-267-A-1967/NAS 938-1962, Axis and Motion Nomenclature for Numerically Controlled Machines

13. Comments: This standard appears to have been developed first as National Aerospace Standard NAS 938-1959, and then modified into EIA, ANSI, and ISO standards.

1. Designation: ANSI X3.42-1975

2. Title: American National Standard for the Representation of Numeric Values in Character Strings for Information Interchange

3. Maintenance Authority: ANSI X3L5

4. Scope: This standard specifies the syntax of the elements of three sets of character strings which are decimal positional representations of numeric values for use in the interchange of numeric values between independent data processing systems and products. This standard also provides guidance for developers of programming standards and implementors of programming products.

5. Relationship to Other Standards: When used to represent all numeric values recorded on storage media or transmitted on data channels conforming to the appropriate American National Standards, would ensure that any recipient of a representation of a number attributes the same value to it as the originator, whether or not they are operating in the same system, programming language, or architecture.

6. Competitive Standards: None

7. Standardization Status: Standard published Aug. 4, 1975, by ANSI. This standard is in the process of international standardization by ISO.

8. Implementation Status: All standard programming languages (PL/I, FORTRAN, COBOL, BASIC, MUMPS) either conform to this standard or are being revised during their current revision cycle to conform to it.

9. Known Manufacturing Uses: All data files that are used by a different programming language than produced them and all data files that are applied on a different computer system or computer architecture.

10. Known Sources of Information: Mrs. Frances E. Holberton, NBS, (301) 921-3491; Mr. William F. Hanrahan, X3 Secretary.

11. Probable Sources of Information:

12. Bibliography: ANSI X3.42-1975

13. Comments:

1. Designation: MEDIA

2. Title: Punched Cards (80-column "IBM" Type)

3. Maintenance Authority: NBS/ANSI/ISO/EIA

4. Scope: Card stock, card and hole dimensions, Hollerith coding

5. Relationship to Other Standards:

ISO Recommendation or Draft Recommendation	Related National Standard	Related Federal Standard (FIPS)
ISO 1679 Representation of ISO 7-Bit Coded Character Set in 12-Row Punched Cards	X3.26-1969 Hollerith Punched Card Code	FIPS PUB 14 Hollerith Punched Card Code
ISO 1681 Specifications for Unpunched Paper Cards	X3.11-1969 Specification for General Purpose Paper Cards for Information Processing	
ISO 1682 Demensions and Locations of Rectangular Punched Holes in 80-Column Punched Paper Cards	X3.21-1967 Rectangular Holes in 12-Row Punched Cards	FIPS PUB 13 Rectangular Holes in 12-Row Punched Cards

6. Competitive Standards:

7. Standardization Status: Summarized in 5 above.

8. Implementation Status: Widely implemented in IBM and other computer installations.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. H. F. Ickes, IBM, (914) 463-9779

11. Probable Sources of Information: Mr. Robert M. Brown, Vice-Chairman of ANSI X3, CBEMA, (202) 466-2288.

12. Bibliography: See 5 above.

13. Comments: Hollerith cards have 80 columns and 12 rows of rectangular holes. They are not compatible with the round hole 90-column cards formerly marketed by UNIVAC, nor with the 96-column cards introduced by IBM with the System 3.

1. Designation: MEDIA

2. Title: Magnetic Tape (1/2 inch, 9 track, Digital)

3. Maintenance Authority: NBS/ANSI/ ISO/ EIA

4. Scope: Unrecorded tape stock, recording formats, bit densities, coding, hubs, reels.

5. Relationship to Other Standards:

ISO Recommendation or Draft Recommendation		Related National Standard	Related Federal Standard (FIPS)
ISO R961	Implementation of the 6 and 7-Bit Coded Character Sets on 7-Track 12.7 mm (1/2 in) Magnetic Tape.		
ISO 962	Implementation of the 7-Bit Coded Character Set on 9-Track, 12.7 mm (1/2 in) Magnetic Tape.		
ISO R1858	General Purpose Hubs and Reels with 76 mm (3 in) Centrehole for Magnetic Tape Used in Interchange Information Applications	RS-346 Type A Hubs and Reels and Magnetic Tape	
ISO R1859	Un recorded Magnetic Tapes for Instrumentation Applications --General Dimensional Requirements		
ISO R1860	Precision Reels for Magnetic Tape Used in Interchange Instrumentation Applications.		
ISO R1861	7-Track 8 rpmm (200 rpi) Magnetic Tape for Information Interchange.		
ISO R1862	9-Track 8 rpmm (200 rpi) Magnetic Tape for Infortion Interchange.	X3.14-1973 Recorded Magnetic Tape for Information Interchange (200 CPI, NRZI)	
ISO RS1863	9-Track 32 rpmm (800 rpi) Magnetic Tape for Information Interchange.	X3.22-1973 Recorded Magnetic Tape for Information Interchange (200 CPI, NRZI)	FIPS PUB 3-1 Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI)
ISO R1864	Unrecorded Magnetic Tape for Information Interchange, 8 and 32 rpmm (200 and 800 rpi), NRZI, and 63 rpmm (1600 rpi), Phase-Encoded.	X3.40-1973 Unrecorded Magnetic Tape for Information Interchange (9-Track 200 and 800 CPI, NRZI, and 1600 CPI, P.E.)	
ISO 2690	Unrecorded Magnetic Tape for Instrument Applications--Physical Properties and Test Methods.		
ISO 3788	9-Track, 64 rpmm (1600 rpi) Magnetic Tape for Information Interchange.	X3.39-1973 Recorded Magnetic Tape for Information Interchange (1600 CPI, P.E.)	FIPS PUB 25 Recorded Magnetic Tape for Information Interchange (1600 CPI, Phase Encoded)
		X3.54-1976 Recorded Magnetic Tape for Information Interchange (6250 CPI, GCR)	
SRM 3200	is used internationally.	SRM 3200 is used nationally.	Standard Reference Material 3200, Secondary Standard Magnetic Tape (Computer Amplitude Reference) (Sold by NBS).

6. Competitive Standards:

7. Standardization Status: Summarized in 5 above.

8. Implementation Status: Widely implemented in computers.

9. Known Manufacturing Uses:

10. Known Sources of Information: Mr. John L. Little, NBS, (301) 921-3723; Mr. Sidney B. Geller, NBS, (301) 921-3723

11. Probable Sources of Information: Mr. Robert M. Brown, Vice-Chairman of ANSI X3, CBEMA, (202) 466-2288.

12. Bibliography: See 5 above.

13. Comments: There are no ANSI or Federal standards for the 7-track tapes shown in 5 above.

1. Designation: FIPS PUB 25/ANSI X3.39-1973

2. Title: Recorded Magnetic Tape for Information Interchange (1600 CPI, Phase Encoded)

3. Maintenance Authority: ANSI X3B1

4. Scope: Hardware Standard. This standard specifies the recorded characteristics of 9-track, one-half inch wide magnetic computer tape, including the data format for implementing the Federal Standard Code for Information Interchange (FIPS 1) on magnetic tape media.

5. Relationship to Other Standards: See FIPS PUB 12-2, pages 17-18 under "Media, Magnetic Tape" for the relationship to 16 other standards dealing with magnetic tape. Also ANSI BSR X3.54 (6250 CPI).

6. Competitive Standards: All 7-track magnetic tape codes. All magnetic tape codes in use prior to 1967. EBCDIC is widely recorded on 9-track magnetic tapes, and such tapes are similar except for the coding.

7. Standardization Status: Magnetic tape standards were first approved in 1967 and have been augmented and updated ever since.

8. Implementation Status: With ASCII coding, as specified in the ANSI magnetic tape standards, these standard tapes are not nearly as widely used as similar tapes with EBCDIC coding, because of the prevalence of IBM System 360 and 370 machines using EBCDIC tapes.

9. Known Manufacturing Uses: Wherever manufacturing uses magnetic tapes.

10. Known Sources of Information: Mr. Michael D. Hogan and Mr. John L. Little, NBS, (301) 921-3723.

11. Probable Sources of Information: IBM, Honeywell, UNIVAC, Burroughs.

12. Bibliography: FIPS PUB 25/ANSI X3.39-1973; FIPS PUB 12-2, pages 17-18.

13. Comments: There have never been any ANSI standards for 7-track magnetic tape. The 9-track standards are identical to IBM 360/370 tapes except that the coding in the standards is specified as ASCII instead of EBCDIC. The 9-track tape was the first 8-bit environment in which 7-bit ASCII was embedded. The technique is to make the high order bit a "zero" bit when the other 7 bits are ASCII bits. Parity is always odd.

Relationships in 9-Track Magnetic Tape

Track No., ANSI X3.22-1967 (FIPS 3)	4	7	6	5	3	9	1	8	2
Environment (8 information bits)	P	E_8	E_7	E_6	E_5	E_4	E_3	E_2	E_1
ASCII (FIPS 1) Bits (high to low)	P	Z	b_7	b_6	b_5	b_4	b_3	b_2	b_1
IBM EBCDIC Bit Numbers (high to low)	P	0	1	2	3	4	5	6	7
Binary Weight (unpacked)	P	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Binary Weight (packed)	P	2^3	2^2	2^1	2^0	2^3	2^2	2^1	2^0
Packed Numeric Digit Order	P		High				Low		

Note that the ASCII low-order bit is b_1, and the EBCDIC low-order bit is bit 7. The packed numeric formats are not standardized. A more complex 10-character, 90-bit Group Encoding Scheme is employed on 6250 bpi magnetic tape.

1. Designation: ANSI BSR X3.48

2. Title: Magnetic Tape Cassette for Information Interchange (Co-Panar, 3.81 mm (0.105 in), 32 bpmm (800 bpi), PE)

3. Maintenance Authority: ANSI X3B5

4. Scope: Hardware Standard. This standard specifies the physical, magnetic, and recorded characteristics for a 3.81 millimeter magnetic tape cassette in order to provide for data interchange between information processing systems at a recording density of 32 bits per millimeter using phase encoding techniques.

5. Relationship to Other Standards: ISO DIS 3407 (technical deviations, probably compatible); ECMA-34, 1973 (technical deviations, probably compatible)

6. Competitive Standards:

7. Standardization Status: Final ANSI approval is pending and publication date is estimated to be August 1976. Designation will be ANSI X3.48-1976.

8. Implementation Status: The ANSI compatible cassette has been implemented widely in communication terminals, POS terminals, intelligent terminals, and minicomputers. It is used in General Electric Terminet 300; Hazeltine 2000, 3000, 5000; Interdata 74; Memorex 1280; Olivetti-P602; Sycor-340E, 310; TI-700 Series; and UNIVAC Uniscope equipments.

9. Known Manufacturing Uses: The ANSI cassette is used as a data storage device in data processing systems designed for scientific, business, and industrial applications.

10. Known Sources of Information: Mr. Raymond C. Smith, 3M Company, Chairman of ANSI X3B5, (612) 733-6297; Mr. Michael D. Hogan, NBS, Member of ANSI X3B5, (301) 921-3723; Mr. William F. Hanrahan, CBEMA, Secretary of ANSI X3, (202) 466-2288.

11. Probable Sources of Information: ANSI X3B5 Membership List (available from CBEMA)

12. Bibliography: ANSI BSR X3.48

13. Comments: It is anticipated that ANSI X3.48-1976 will be available by August 1976. A FIPS PUB adopting the requirements of ANSI X3.48-1976 has been drafted for Federal and public review.

1. Designation: ANSI BSR X3.56

2. Title: Magnetic Tape Cartridge for Information Interchange, 4 Track, 0.250 inch (6.30 mm), 1600 bpi (63 bpmm), Phase Encoded.

3. Maintenance Authority: ANSI X3B5

4. Scope: Hardware Standard. This standard specifies the recorded characteristics for 0.250 inch magnetic tape cartridge in order to provide for data interchange between information processing systems at a recording density of 1600 bits per inch using phase encoding techniques.

5. Relationship to Other Standards: ANSI BSR X3.55 (base); ISO DIS 4057 (technical deviations, probably compatible); ECMA-46, 1976 (technical deviations, probably compatible)

6. Competitive Standards:

7. Standardization Status: Final ANSI approval is pending and publication date is estimated to be late 1976. Designation will be ANSI X3.56-1976.

8. Implementation Status: The ANSI compatible cartridge has been chosen for use in many minicomputers and communication terminals. It is used in the Three Phoenix TCT-300, the Kennedy Co. 4344/45/46 digital cartridge recorders, and the Mohawk Data Sciences 2021/2022 cartridge tape drive, for example.

9. Known Manufacturing Uses: The ANSI compatible cartridge is used as a data storage device in data processing systems designed for scientific, business, and industrial applications.

10. Known Sources of Information: Raymond C. Smith, 3M Company, Chairman of ANSI X3B5 (612) 733-6297; Michael D. Hogan, NBS, Member of ANSI X3B5, (301) 921-3723; Mr. William F. Hanrahan, CBEMA, Secretary of ANSI X3, (202) 466-2288.

11. Probable Sources of Information: ANSI X3B5 Membership List (available from CBEMA)

12. Bibliography: ANSI BSR X3.56; ANSI BSR X3.55

13. Comments: ANSI BSR X3.55, Unrecorded Magnetic Tape Cartridge for Information Interchange, 0.250 inch (6.30 mm), 1600 bpi (63 bpmm), Phase Encoded, contains the mechanical and magnetic requirements for the 0.250 inch magnetic tape cartridge. It supports ANSI BSR X3.56 and will be published concurrently.

1. Designation: MEDIA

2. Title: Paper tape (one inch, 8-track)

3. Maintenance Authority: NBS/ ANSI/ ISO

4. Scope: Paper stock, tape and hole dimensions, coding, reels, rolls

5. Relationship to Other Standards:

ISO Recommendation or Draft Recommendation	Related National Standard	Related Federal Standard (FIPS)
ISO 1113 Representation of 6 and 7-Bit Coded Character Sets on Punched Tape	X3.6-1965 Perforated Tape Code for Information Interchange	FIPS PUB 2 Perforated Tape Code for Information Interchange
ISO 1154 Dimensions for Punched Paper Tape for Data Interchange	X3.18-1967 One-Inch Perforated Paper Tape for Information Interchange	FIPS PUB 26 One-Inch Perforated Paper Tape for Information Interchange
	X3.19-1967 Eleven-Sixteenths Inch Perforated Paper Tape for Information Interchange	
ISO 1729 Properties of Unpunched Paper Tape	X3.29-1971 Specifications for Properties of Unpunched Oiled Paper Perforator Tape	
	X3.20-1967 Take-Up Reels for One-Inch Perforated Tape for Information Interchange	FIPS PUB 27 Take-Up Reels for One-Inch Perforated Tape for Information Interchange
ISO 2195 Data Interchange on Rolled Up Punched Paper Tape--General Requirements		

6. Competitive Standards:

7. Standardization Status: Summarized in 5 above.

8. Implementation Status: Widely implemented in minicomputers, teletype machines, certain other computer terminals.

9. Known Manufacturing Uses: Widely used to drive numerically controlled machine tools.

10. Known Sources of Information: Mr. John L. Little, NBS, (301) 921-3723

11. Probable Sources of Information: Teletype Corporation

12. Bibliography: See 5 above.

13. Comments: Some tapes contain Mylar plastic to resist tearing. Dimensions of such tapes are the same as for paper tapes. Dye is used in some tapes to improve optical reading of the holes. The 11/16 inch width of ANSI X3.19-1967 tape accommodates only 5 tracks for communications in "Baudot" 5-bit code.

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15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This report identifies and evaluates those existing and potential standards which will be useful to the Air Force in the development and implementation of integrated computer aided manufacturing (ICAM) systems. Such systems, when implemented by the Air Force and by Air Force contractors, will increase productivity in discrete part batch manufacturing by several thousand percent. The use and importance of standards are considered in the context of CAM systems. Since the Air Force will develop the detailed ICAM architecture after this study is complete, existing system concepts and architectures are examined to identify the common elements to guide the further presentation and discussion of relevant standards. The second interim report provides summaries of standards relevant to CAM.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

CAM architectures; computer aided manufacturing; computer systems; standards; system integration; voluntary standards.

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